PB81-178246

Wastewater Management for Boise, Eagle, and Ada County, Idaho. Appendix A Through H

(U.S.) Environmental Protection Agency
Seattle, WA

Feb 81

U.S. Department of Commerce
National Technical Information Service
NTIS

EPA 910/9-81-084

United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

PB81-178246

EPA-10-ID-Boise/Eagle-Ada-WWTW-81

Environmental Impact Statement Appendices

Draft

Wastewater Management for Boise, Eagle, and Ada County, Idaho

PRODUCT OF:
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC INFORMATION

PB81-178246

Wastewater Management for Boise, Eagle, and Ada County, Idaho. Appendix A Through H.

Feb 81,

PERFORMER: Environmental Protection Agency, Seattle, WA.
EPA/910/9-81-084-APP

See also PB81-178196. Prepared in cooperation with Jones and Stokes Associates, Inc., Sacramento, CA.

Contents: Emission inventory and forecasting procedures; Fiscal overview on Ada County; Population projections for Ada County EIS analysis; Drainage; Partial species list, Ada County; Hourly carbon monoxide emissions by community planning area: 1977, 1980, 1987 and 2000; Summary of existing carbon monoxide monitoring data; Procedures used to evaluate future air pollution potential in Ada County.

KEYWORDS: *Sewage treatment, *Environment impact statements-draft.

Available from the National Technical Information Service, Springfield, Va. 22161

PRICE CODE: PC A08/MF A01

TABLE OF CONTENTS

APPENDIX A - EMISSION INVENTORY AND FORECASTING PROCEDURES

APPENDIX B - FISCAL OVERVIEW ON ADA COUNTY

APPENDIX C - POPULATION PROJECTIONS FOR ADA COUNTY EIS ANALYSIS

APPENDIX D - DRAINAGE

APPENDIX E - PARTIAL SPECIES LIST, ADA COUNTY

APPENDIX F - HOURLY CARBON MONOXIDE EMISSIONS BY COMMUNITY PLANNING AREA: 1977, 1980, 1987 and 2000

APPENDIX G - SUMMARY OF EXISTING CARBON MONOXIDE MONITORING DATA

APPENDIX H - PROCEDURES USED TO EVALUATE FUTURE AIR POLLUTION POTENTIAL IN ADA COUNTY

Appendix A

EMISSION INVENTORY AND FORECASTING PROCEDURES

Prepared by:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

January 1981

TABLE OF CONTENTS

Page

INTRODUCTION A-1

HIGHWAY TRAFFIC EMISSIONS A-3
    Summary of Traffic Model Characteristics A-3
    Emission Calculation Procedure A-4
    Default Parameter Inputs to MOBILE 1 A-7
        Temperature A-7
        Vehicle Speed A-9
        Vehicle Age Distribution A-9
        Age-Dependent Annual Mileage A-9
        Hourly Percent ADT A-9
        Directional Split A-13
        Vehicle Fleet Mix A-13
        Vehicle Operating Mode A-13

PARKING ACTIVITY EMISSIONS A-16
    Basic Approach A-16
        Parking Facility Data Files A-16
        General Calculation Procedure A-19
    Equations and Default Parameter Values A-25
    Default Vehicle Movement Patterns A-32

RESIDENTIAL FUEL COMBUSTION EMISSIONS A-44

REFERENCES CITED A-48

LIST OF TABLES

Table		Page
1	Highway Projects Added to 1975 Conditions to Develop Traffic Model Network for Future Years	A-5
2	Default Temperature Pattern for the Boise Area	A-8
3	Default Speed Values Used for the Highway Emission Model	A-10
4	Vehicle Age Distribution Used in the Highway Emissions Program	A-11
5	Parameter Values Specified as a Function of Time-of-Day and Roadway Speed Group	A-12
6	Average Vehicle Fleet Composition in the Boise Area	A-14
7	Parameter Values for Surface Lot Test Case Analyses	A-21
8	Parking Garage Evaluation Assuming 2, 3, and 4 Levels With a Single Entrance on the First Level	A-22
9	Percent Idling Incorporated into MOBILE 1 Emission Rates at Various Speeds	A-24
10	Parameters Used in the Parking Emissions Model	A-26
11	Parameter Designations Used in the Computer Program	A-27
12	Equations in the Parking Emissions Model	A-29
13	Parameter Values Defined as a Function of Total Parking Spaces and/or Parking Facility Type	A-30
14	Default Temperature Pattern for the Boise Area	A-31
15	Default Operating Mode Parameters	A-33

List of Tables, Cont'd.

Table		Page
16	Percent of Boise Vehicle Fleet Expected to be Equipped With Catalytic Converters	A-34
17	Default Guidance for Parking Duration Category and Parking Activity Index Assignments	A-36
18	Characteristics of Short-Term Parking Movement Patterns	A-37
19	Characteristics of Intermediate-Term Parking Movement Patterns	A-38
20	Characteristics of Long-Term Parking Movement Patterns	A-39
21	Default Parking Movement Patterns	A-40
22	Data and Assumptions Used for Estimating Carbon Monoxide Emissions From Residential Fuel Combustion Sources	A-45

LIST OF FIGURES

Figure		Page
1	Geographic Coverage of Off-Street Parking Inventory	A-18

EMISSION INVENTORY AND FORECASTING PROCEDURES

Introduction

Most air quality management activities involve the control of pollutant emissions from various sources. It is important, therefore, to have reasonable estimates of current and future emissions so that effective air quality management programs can be designed. It is usually impractical to attempt direct measurement of pollutant emissions from all sources in an urban area. Emission inventories (estimates of historical or current emissions) and forecasts (projections of future emissions) are usually prepared by extrapolating emission rate data to local conditions. Depending on the emission sources being considered, available emission rate data will usually reflect a limited amount of direct emission measurements plus calculations based on various assumptions.

Carbon monoxide emissions have been estimated for several groups of emission sources in northern Ada County. The greatest attention has been devoted to sources in the Boise metropolitan area, since air quality monitoring data have documented serious carbon monoxide problems throughout the Boise area. Emission estimates have been structured to reflect historical conditions for 1977 and 1980, and expected conditions for 1987 and 2000. Three broad categories of emission sources have been evaluated: vehicle traffic on major roadways, on- and off-street vehicle parking activity, and residential fuel combustion for space heating or appliance operation. Commercial and industrial fuel combustion emissions have not been estimated. Data for residential fuel combustion suggest that commercial and industrial sources are probably insignificant. Drive-up window facilities have not been directly evaluated for the emission inventories and forecasts discussed here. Data for parking facilities suggest that drive-up facilities may be significant localized emission sources.

Emission inventory and forecasting procedures for vehicle traffic and parking activity were computerized to allow detailed evaluation of geographic and temporal emission patterns. Residential fuel combustion emission estimates were not computerized.

The highway traffic and parking activity emission forecasting procedures involve a series of interrelated computer programs that are linked to a single main program. Both the highway traffic and parking activity analyses used the

MOBILE 1 computer program to determine vehicle emission rates. The MOBILE 1 program (EPA 1978b) was modified to perform an altitude interpolation procedure.

The MOBILE 1 program is designed to estimate vehicle emissions for either low altitude (near sea level) or high altitude (over 4,000 feet) conditions. Boise is at an elevation of about 2,700 feet. The altitude interpolation procedure was accomplished through interpolation of values in the "block data" section of MOBILE 1. The interpolation procedure was applied to the following MOBILE 1 parameter tables: new vehicle exhaust emissions, exhaust emission deterioration rates, new vehicle idle emissions, idle emission deterioration rates, and the speed correction factor coefficients. The specific interpolation procedure used for the Boise area is given below.

$$B = L + (0.63)\ (H - L)$$

Where: B = Parameter value for Boise (2,700 feet)
L = Low altitude parameter value (500 feet)
H = High altitude parameter value (4,000 feet)

A consistent set of population, land use, and employment projections (Ada Planning Association 1978) has been used as a base for all emission inventories and forecasts. The Boise area traffic model also uses these same projections. The various parameter inputs required for the highway traffic and parking emissions forecasts were developed in consultation with staff from the U. S. Environmental Protection Agency (EPA), Idaho Air Quality Bureau, and Ada Planning Association (APA). In most cases, however, final parameter values were established by Jones & Stokes Associates staff. Actual computer programming was performed by COMSIS Corporation. The resulting computer programs were installed on the Idaho Transportation Department computer system (IBM 370/158).

The computer programs developed for Boise contain one feature which greatly reduces program execution time. Emission rates (grams per mile factors) calculated by the MOBILE 1 program are stored for repeated use. This avoids the necessity of executing the complete MOBILE 1 program for each highway link or parking facility movement.

The discussions that follow focus on data sources, key assumptions, and general calculation procedures. The intent is to allow an independent and critical evaluation of the resulting emission forecasts. These discussions are not intended as a manual for performing actual computer runs. For simplicity, the following descriptions will treat the highway traffic and parking components as if they were separate procedures. As noted above, they were actually incorporated into a single main computer program to simplify the linkage to the modified MOBILE 1 program.

Highway Traffic Emissions

Most carbon monoxide emission inventories and forecasts focus on emissions from highway traffic. Since the introduction of the MOBILE 1 program, many state and local agencies have approached this task by linking the MOBILE 1 program to traffic model output. Previous emission inventory efforts in Ada County (Benesh and Wiltsee 1979) utilized a portion of the APRAC 2 program for this purpose. The emissions module in the APRAC 2 program provides a geographical distribution of emissions only in terms of a user-specified grid network. Most land use and transportation planning activities of APA are correlated with community planning areas and component traffic zones.

Although the APRAC 2 program was available to APA staff, uncertainties regarding its use led to consideration of other approaches. The HWYEMIS 1 program was obtained from the Federal Highway Administration. This program proved reasonably easy to use, although the version received had some program errors. A major limitation of the HWYEMIS 1 program is its use of four fixed time intervals for providing emission inventory output. These time intervals do not correspond to the times when Boise experiences violations of the federal 8-hour carbon monoxide standard. Data inputs to HWYEMIS 1 can be manipulated to obtain emissions for any desired time period, but this is a bothersome procedure.

A decision was eventually made to develop a new program oriented toward hourly emission calculations with multiple geographic output formats. The resulting program operates in much the same way as the APRAC 2 emissions module, HWYEMIS 1, and similar programs. Traffic model output is taken on a link-by-link basis, combined with input of other essential data assumptions, and used to run the MOBILE 1 program. Resulting emission calculation results are then stored for later aggregation into the desired output format.

Summary of Traffic Model Characteristics

The traffic model for northern Ada County uses a system of 237 traffic zones. The Boise Metropolitan Area is divided into 148 zones while the remaining areas of northern Ada County are treated as 73 zones. The remaining 16 zones represent traffic from outside the northern Ada County area. Traffic zones in the metropolitan area average about 450 acres in size, with rural areas represented by larger zones than those used for the City of Boise. Traffic zones in the remainder of northern Ada County vary considerably in size, depending on the extent of development. Overall, these zones average about 4,900 acres in size. The existing highway network in the traffic model is represented by 1,278 highway segments (links) averaging about 0.42 mile in length.

The traffic model is based largely on standard Urban Transportation Planning System (UTPS) computer programs (COMSIS Corporation, 1978). The trip generation component is based on three internal trip types (home-based work [HBW], home-based other [HBO], and nonhome based [NHB]) and two external trip types (production internal/attraction external [PI-AX] and production external/attraction internal [PX-AI]). Trip generation rates are based on socio-economic characteristics of each traffic zone in the model. Person-trips are converted to vehicle-trips using an average vehicle occupancy factor of 1.33 for HBW, HBO, and NHB trips and a factor of 1.67 for PI-AX and PX-AI trips.

Trip attractions are developed by traffic zone primarily on the basis of employment categories and number of dwelling units in the zone. A "special generators" program accounts for hospitals, shopping centers, schools, the airport, and the Boise State University campus. A balanced matrix of zone-to-zone trip productions and attractions is eventually produced. The traffic model does not account for trips occurring entirely within a single traffic zone. The generally small size of traffic zones in the urbanized area of the county makes such intrazonal trips a minor component of overall travel patterns.

Trips are assigned to specific roadways by normal "gravity model" procedures. These procedures consider overall travel times (a function of distance and speed) for alternative routes between particular pairs of traffic zones. The model currently uses three iterations of a "capacity restraint" process to account for traffic congestion in evaluating alternative trip routes. This capacity restraint process reduces assumed vehicle speeds according to a volume/capacity ratio technique.

The traffic volumes assigned to specific roadways by the model are in general agreement with observed traffic patterns. Inaccuracies in traffic assignments on some roadways are, of course, inevitable. When emissions are aggregated by community planning area, overall inaccuracies are minimized.

The highway network initially established for the traffic model represented 1975 conditions. This 1975 network was used for 1977 conditions also. The highway network used for 1980 conditions was updated to reflect highway projects completed since 1975. Additional highway projects were assumed for the 1987 and 2000 networks (Table 1).

Emission Calculation Procedure

The traffic model supplies only a small portion of the data needed as input to the MOBILE 1 program. Most parameter inputs for MOBILE 1 must be provided from another source. The highway links in the traffic model are categorized by

Table 1. Highway Projects Added to 1975 Conditions to Develop Traffic Model Networks for Future Years

Year	Projects Added to Network For Previous Year	Comments
1977	-	No projects added to 1975 network
1980	Southeast Corridor	Broadway to Pennsylvania
	Overland Road	Widen from two lanes to four lanes between Curtis and Cole
	Emerald Extension	From Cole to Maple Grove
	Milwaukee	From Ustic to Franklin Road
	State Street Widening	Six lanes, 23rd to 27th; left turn bays, 27th to 36th
	Franklin Road	Widen to four lanes with left turn bays, Cole to Maple Grove and Orchard to Curtis
1987	Southeast Corridor	Four lanes, Pennsylvania to Apple Street to Boise Avenue
	Overland Road	Widen to five lanes, Orchard to Curtis
	State/Jefferson	Reverse one-way flows, 16th to 1st Streets
	Idaho and Main Closures	Block off both streets between Capital and 9th Street
	Bannock Street	Reverse flow from 2nd to 16th Streets
	East Boise Avenue	Widen to four lanes, Gekler to Greenwood
	9th Street and Capital	Establish one-way couplet system around City Center project
	Vista Avenue	Signalization and intersection improvements, Ridenbaugh Canal to Federal Way
	State Street	Widen to five lanes, 36th Street to Glenwood
	10th Street Reversal	Reverse one-way flow, Front Street to State Street
	Chinden-Broadway Interim Connection	Extend Myrtle to Main/Fairview and provide interim connection to Main/Fairview couplet Extend Front Street to Broadway
	Meridian Interchange	Construct Southeast on-ramp to I-80N

Table 1 (cont'd.)

Year	Project Added to Network For Previous Year	Comments
	Highway 21	Relocate Highway 21, Diversion Dam to Gowen Road interchange
	Eagle Road Bypass	Construct bypass of Highway 44 on south side of Eagle
	13th Street	Change to two-way traffic between Front and Borah
2000	Boise River Crossing	New river crossing between existing Fairview/Main and Glenwood bridges
	Southeast Corridor	Entire project, including both the east and west crossings of the Boise River
	Vista Avenue	Widening to four lanes and other improvements, Overland to Malad
	Chinden-Broadway Connection	East-west connection between Chinden Boulevard and Broadway Avenue
	Rosehill/Franklin Road	Intersection improvement and widening
	Bannock Street Extension	From 16th Street to Main
	Glenwood Extension	From Mountain View to Cole Road
	State Street	Widen from 36th to Glenwood
	Franklin Road	Widen, Curtis to Cole
	15th/16th couplet	One-way couplet, Front to Shoreline
	State Street/Jefferson couplet	Complete Avenue B portion at east end of project; improvements at west end of project

SOURCE: Nelson 1981.

a facility type code and an area type code. The traffic model assigns free-flow speeds and hourly lane capacities on the basis of these facility type-area type combinations. These same facility type-area type codes were used to classify all roadway links into one of three speed-based categories for the highway emissions program:

- High speed roadways with free-flow speeds of 50-57.5 mph; median = 53.8 mph
- Medium speed roadways with free-flow speeds of 30-47.5 mph; median = 38.8 mph
- Low speed roadways with free-flow speeds of 15-27.5 mph; median = 21.3 mph

Different sets of MOBILE 1 parameters were developed for each of these three roadway groups.

The program for calculating highway traffic emissions analyzes traffic model output on a link-by-link basis. For each link, emissions are calculated on an hourly basis. Average daily traffic volumes from the traffic model are factored into hourly volumes. For two-way streets, these hourly volumes are further split by direction. Volume/capacity ratios and a default speed table are used to calculate a weighted average speed for the total traffic volume on the link. This weighted average speed, the total hourly volume, the length of the link (from the "historical record" data file of the traffic model), and various other parameter inputs are used with the MOBILE 1 program to calculate vehicle emissions on the link. The weighted average speed computation was used to reflect the directional split of hourly traffic (and resulting differences in traffic congestion) without doubling the number of MOBILE 1 calculations required for the emissions program.

Default Parameter Inputs to MOBILE 1

Temperature. A default hourly temperature curve was established in consultation with the Idaho Air Quality Bureau (Table 2). The MOBILE 1 program does not accept temperatures below 0°F. The adopted temperature curve is considered representative of a cold winter day in Boise, but is not based on any statistical analysis of daily temperature records.

Table 2. Default Temperature Pattern for the Boise Area

Clock Hour	Temperature (°F)	Clock Hour	Temperature (°F)
1	0	13	16
2	0	14	18
3	0	15	20
4	0	16	18
5	0	17	16
6	0	18	14
7	2	19	12
8	6	20	10
9	8	21	8
10	10	22	6
11	12	23	4
12	14	24	2

Notes: Clock hours are designated by the end of the hour. Thus, hour 8 = 7:00 a.m. to 8:00 a.m. and hour 17 = 4:00 p.m. to 5:00 p.m.

Vehicle Speed. The traffic emissions program is structured to obtain the speed input to MOBILE 1 from any of three sources:

- From a default speed table based on volume capacity ratios.
- From a default table giving fixed speed values based on time of day.
- From the traffic model link data files.

All emissions inventory and forecast work has used the first option (Table 3). The second option was considered too arbitrary. The third option seems, on the surface, to be the most logical procedure. The traffic model, however, is oriented primarily toward daily traffic volumes. The speed values listed in the historical record data file are not directly applicable to any specific hourly flow volume.

Vehicle Age Distribution. Previous emission inventory work for the Boise area (Benesh and Wiltsee 1979) established a vehicle age distribution table for the Boise area (Table 4). This table was based on vehicle registration data for Ada County (apparently for 1977). The national average default age distribution contained in the "block data" section of the MOBILE 1 program has been replaced by the data in Table 4.

Age-Dependent Annual Mileage. The national average default values were used for the vehicle age-dependent annual mileage accumulations. Data specific to the Boise area were not readily available.

Hourly Percent ADT. The average daily traffic (ADT) values generated by the traffic model are converted by the emissions program into hourly traffic volumes. Default values for the three roadway categories are shown in Table 5 (PCTADT). The values for high speed roadways are taken from Benesh and Wiltsee (1979). The values for medium and low speed roadways were developed from traffic count data provided by the Idaho Transportation Department (ITD). Daily traffic counts for December 1975, November 1976, December 1977, and November 1978 were used. Four count stations were used to develop the medium speed roadway data:

- State Street (Highway 44) between 23rd and 24th Streets.
- Fairview Avenue at the Boise River Bridge.
- Main Street at the Boise River Bridge.
- Broadway Avenue at the Boise River Bridge.

Three count stations were used to develop the low speed roadway data:

- Warm Springs Avenue (Highway 21) between Walnut and Locust.

Table 3. Default Speed Values Used for the Highway Emissions Model

$\frac{V}{0.75C}$	Speed Values (mph)		
	High Speed Roadways	Medium Speed Roadways	Low Speed Roadways
0.1	53.8	38.8	21.3
0.2	53.8	38.8	21.3
0.3	53.8	38.8	21.3
0.4	53.8	38.8	21.3
0.5	53.8	38.8	21.3
0.6	53.8	38.8	21.3
0.7	53.8	38.8	21.3
0.8	50.7	36.6	20.1
0.9	49.0	35.3	19.4
1.0	46.8	33.7	18.5
1.1	44.1	31.8	17.5
1.2	41.0	29.6	16.2
1.3	37.7	27.2	14.9
1.4	34.1	24.6	13.5
1.5	30.6	22.1	12.1
1.6	27.1	19.6	10.7
1.7	23.9	17.2	9.5
1.8	20.9	15.1	8.3
1.9	18.2	13.1	7.2
2.0	15.8	11.4	6.3
2.1	13.7	9.9	5.4
2.2	11.9	8.6	4.7
2.3	10.4	7.5	4.1
2.4	9.0	6.5	3.6

Notes: Speed values calculated from the following equations:

When $\frac{V}{0.75C} \geq 0.8$:

$$S' = S_o \div \left(1 + [0.15]\left[\left(\frac{V}{0.75C}\right)^4\right]\right)$$

When $\frac{V}{0.75C} < 0.8$:

$$S' = S_o$$

Where:

S' = adjusted speed

S_o = free flow speed assigned to roadway group

V = hourly volume for a specified direction on a highway link

C = hourly capacity of the highway link for the specified direction; obtained from the historical record file of the traffic model

Table 4. Vehicle Age Distribution Used in the Highway Emissions Program

	Vehicle age (years)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
LDA	0.045	0.086	0.087	0.066	0.083	0.090	0.086	0.069	0.065	0.062	0.054	0.047	0.040	0.039	0.028	0.010	0.014	0.008	0.006	0.004
LDT	0.036	0.081	0.080	0.065	0.077	0.094	0.083	0.057	0.060	0.059	0.051	0.042	0.042	0.038	0.033	0.026	0.021	0.015	0.016	0.025
MDT	0.036	0.081	0.080	0.065	0.077	0.094	0.083	0.057	0.060	0.059	0.051	0.042	0.042	0.038	0.033	0.026	0.021	0.015	0.016	0.025
HDG	0.096	0.069	0.067	0.107	0.130	0.102	0.062	0.057	0.063	0.042	0.037	0.037	0.028	0.018	0.016	0.014	0.009	0.008	0.006	0.024
HDD	0.095	0.093	0.057	0.102	0.119	0.096	0.061	0.054	0.063	0.044	0.037	0.038	0.033	0.023	0.016	0.014	0.008	0.008	0.007	0.039
MC	0.030	0.074	0.079	0.134	0.135	0.144	0.108	0.094	0.075	0.050	0.030	0.024	0.023							

Notes:

LDA - light duty autos

LDT - light duty trucks

MDT - medium duty trucks

HDG - heavy duty gasoline-powered vehicles

HDD - heavy duty diesel-powered vehicles

MC - motorcycles

SOURCE: Benesh and Wiltsee 1979.

Reproduced from
best available copy.

Table 5. Parameter Values Specified as a Function of Time-of-Day and Roadway Speed Group

HR-->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
CURVE SET 1																								
PCTADT	1.5	1.0	0.5	0.5	1.5	3.5	6.0	7.0	6.0	4.5	3.5	4.0	4.5	4.0	5.5	7.0	8.0	8.0	6.0	4.5	4.0	3.5	3.0	2.5
PCTDIR	46.7	50.0	60.0	60.0	53.3	57.1	53.3	58.6	53.3	51.1	45.7	45.0	40.0	45.0	45.5	45.7	45.0	45.0	45.0	43.9	50.0	48.6	46.7	48.0
PCTVEH 1	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
2	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
4	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
5	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
PCTCND 1	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	35.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	30.0	30.0	10.0	10.0	10.0	10.0	10.0	10.0
2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
3	30.0	30.0	30.0	30.0	30.0	30.0	30.0	70.0	70.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	70.0	70.0	30.0	30.0	30.0	30.0	30.0	30.0
CURVE SET 2																								
PCTADT	0.9	0.6	0.3	0.2	0.2	0.4	1.5	6.5	6.3	5.0	5.4	6.5	7.3	7.2	7.0	7.4	8.3	8.1	5.4	4.3	3.3	3.1	2.5	1.8
PCTDIR	47.3	50.5	48.9	50.9	53.5	56.5	56.3	68.6	62.7	54.7	51.9	49.3	48.9	50.4	48.2	47.0	42.4	38.4	44.9	50.3	47.2	45.6	47.0	47.4
PCTVEH 1	72.2	72.2	72.2	72.2	72.2	72.2	72.2	69.7	69.7	57.5	57.5	57.4	57.5	57.5	57.5	57.5	69.8	69.8	72.2	72.2	72.2	72.2	72.2	72.2
2	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.0	24.0	19.7	19.7	19.8	19.8	19.8	19.8	19.8	24.0	24.0	24.8	24.8	24.8	24.8	24.8	24.8
3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.6	1.6	7.1	7.1	7.1	7.1	7.1	7.1	7.1	1.5	1.5	0.5	0.5	0.5	0.5	0.5	0.5
4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	3.1	3.1	14.1	14.1	14.1	14.0	14.0	14.0	14.0	3.1	3.1	0.9	0.9	0.9	0.9	0.9	0.9
5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
PCTCND 1	10.0	10.0	10.0	10.0	10.0	10.0	10.0	45.0	45.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	35.0	35.0	10.0	10.0	10.0	10.0	10.0	10.0
2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
3	30.0	30.0	30.0	30.0	30.0	30.0	30.0	75.0	75.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	65.0	65.0	40.0	40.0	40.0	40.0	40.0	40.0
CURVE SET 3																								
PCTADT	1.0	0.6	0.3	0.2	0.2	3.4	1.5	5.7	5.8	5.0	5.5	6.5	7.5	7.3	7.0	7.3	8.2	8.2	5.6	4.4	3.6	3.5	2.7	1.8
PCTDIR	47.3	50.5	48.9	50.9	53.5	56.5	56.3	68.6	62.7	54.7	51.9	49.3	48.9	50.4	48.2	47.0	42.4	38.4	44.9	50.3	47.2	45.6	47.0	47.4
PCTVEH 1	72.2	72.2	72.2	72.2	72.2	72.2	72.2	69.7	69.7	57.5	57.5	57.4	57.5	57.5	57.5	57.5	69.8	69.8	72.2	72.2	72.2	72.2	72.2	72.2
2	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.0	24.0	19.7	19.7	19.8	19.8	19.8	19.8	19.8	24.0	24.0	24.8	24.8	24.8	24.8	24.8	24.8
3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.6	1.6	7.1	7.1	7.1	7.1	7.1	7.1	7.1	1.5	1.5	0.5	0.5	0.5	0.5	0.5	0.5
4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	3.1	3.1	14.1	14.1	14.1	14.0	14.0	14.0	14.0	3.1	3.1	0.9	0.9	0.9	0.9	0.9	0.9
5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
PCTCND 1	25.0	25.0	25.0	25.0	25.0	25.0	25.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	35.0	35.0	25.0	25.0	25.0	25.0	25.0	25.0
2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0
3	60.0	60.0	60.0	60.0	60.0	60.0	60.0	65.0	65.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	75.0	75.0	60.0	60.0	60.0	60.0	60.0	60.0

NOTES: This table has been prepared using a computer printout from the traffic emissions program.

Curve set 1 = parameter values for high speed roadways.
Curve set 2 = parameter values for medium speed roadways.
Curve set 3 = parameter values for low speed roadways.

PCTADT = hourly traffic volume as percent of average daily traffic volume.
PCTDIR = percent of hourly traffic volume heading toward downtown Boise.
PCTVEH = vehicle fleet composition (percent):
- 1 = light duty autos
- 2 = light duty trucks
- 3 = medium duty trucks
- 4 = heavy duty gasoline-powered vehicles
- 5 = heavy duty diesel-powered vehicles
- 6 = motorcycles

PCTCND = vehicle operating mode parameters (percent):
- 1 = noncatalyst vehicle VMT in a cold start mode (PCCO)
- 2 = catalyst vehicle VMT in a hot start mode (PCHS)
- 3 = catalyst vehicle VMT in a cold start mode (PCCC)

- Capitol Boulevard (Highway 30) at the Boise River Bridge.
- 8th Street at the Boise River Bridge.

The hourly traffic volume factors listed in Table 5 represent weighted averages of winter weekday traffic conditions for the months identified above. The traffic model ADT estimates represent average weekday conditions. Emission estimates for other conditions (weekends, holidays, summer, etc.) could be generated by adjusting the traffic model ADT values and/or the hourly percent ADT values.

Directional Split. Hourly directional split assumptions are shown in Table 5 (PCTDIR entries). The values for high speed roadways were taken from Benesh and Wiltsee (1979). The values for both medium and low speed roadways were based on the ITD traffic count data for Fairview Avenue and Main Street.

Vehicle Fleet Mix. Benesh and Wiltsee (1979) made an estimate of average freeway and nonfreeway vehicle fleet compositions. The relative mixes of various truck categories were adjusted by Jones & Stokes Associates staff to reflect more realistic assumptions. The resulting average vehicle fleet mixes (Table 6) were then used to develop the hourly fleet mix values shown in Table 5 (PCTVEH values).

Hourly vehicle fleet mix assumptions were calculated in consultation with various state and local agency staff. The fleet mix for high speed roadways was kept constant for all hours. The fleet mix for medium and low speed roadways was adjusted in an attempt to reflect the concentration of delivery truck activities during normal workday hours. The overall daily fleet mix for these two roadway types (Table 6) has been maintained in the hourly fleet mix values. This was accomplished by recognizing the hourly traffic distribution obtained from the ITD traffic count stations. The hourly fleet mix values in Table 5 effectively allocate 82 percent of the medium-duty and heavy-duty gasoline truck traffic to the 9:00 a.m. to 4:00 p.m. time period.

Vehicle Operating Mode. The MOBILE 1 program calculates separate emission rates for catalyst-equipped and noncatalyst light- and medium-duty vehicles. The MOBILE 1 program then uses the calendar year, the vehicle age distribution table, and the age-dependent vehicle mileage data to calculate appropriate weighting factors and to generate age- and VMT-weighted vehicle-type composite emission rates.

Because initial calculations are done separately for catalyst-equipped and noncatalyst vehicles, vehicle operating mode data must be specified separately for these two groups.

Table 6. Average Vehicle Fleet Composition in the Boise Area

Vehicle Class	Average Vehicle Mix	
	High Speed Roadways	Low and Medium Speed Roadways
Light duty autos	68.0%	67.5%
Light duty trucks	15.5%	23.2%
Medium duty trucks	1.7%	2.6%
Heavy duty gasoline vehicles	8.0%	5.0%
Heavy duty diesel vehicles	6.6%	0.7%
Motorcycles	0.2%	0.9%

DATA SOURCE: Modified from Benesh and Wiltsee 1979 by Jones & Stokes Associates staff.

The MOBILE 1 program recognizes three possible operating modes for a vehicle: cold start, hot start, and hot stabilized. The cold start mode represents the first 505 seconds of vehicle operation following an engine-off period of at least 1 hour for catalyst-equipped vehicles or at least 4 hours for a noncatalyst vehicle. The hot start mode represents the first 505 seconds of vehicle operation following an engine-off period of less than 1 hour for catalyst-equipped vehicles or less than 4 hours for noncatalyst vehicles (assuming the vehicle was in a hot stabilized mode prior to the engine-off period). The hot stabilized mode represents all vehicle operation occurring more than 505 seconds after the engine is started.

Catalyst-equipped vehicles revert to a cold operating mode after a much shorter parking duration than do noncatalyst vehicles. Consequently, catalyst-equipped vehicles will normally have a greater portion of total travel in a cold start mode, and less in a hot start mode, than will noncatalyst vehicles. Given similar travel patterns, catalyst-equipped and noncatalyst vehicles will have the same portion of total travel in a hot stabilized mode.

The MOBILE 1 program assumes identical vehicle age-related travel patterns for catalyst-equipped and noncatalyst vehicles. Consequently, specifying any three of the four catalyst/noncatalyst cold start/hot start parameters allows calculation of the cold start/hot start/hot stabilized parameters for both catalyst-equipped and noncatalyst vehicles. The MOBILE 1 program input requirements specify the following data inputs:

- o PCCO = percent of noncatalyst vehicle VMT which occurs in a cold start mode.
- o PCHS = percent of catalyst-equipped vehicle VMT which occurs in a hot start mode.
- o PCCC = percent of catalyst-equipped vehicle VMT which occurs in a cold start mode.

The traffic model provides data which can be used to estimate the daily average hot stabilized VMT percentage (equal for both catalyst-equipped and noncatalyst vehicles). Splitting the remaining start mode VMT into cold start and hot start components requires data or estimates of vehicle parking duration patterns. Data and assumptions used for the parking emissions model were used to generate the PCCO, PCHS, and PCCC values shown in Table 5.

Parking Activity Emissions

Emissions associated with vehicle parking activity are not routinely accounted for in urban area emission inventories. Consequently, there are few standardized procedures for evaluating such emission sources. The EPA has published one procedure for evaluating emissions from parking lots (EPA 1978a). The procedure in that report requires extensive facility-specific engineering data. These data requirements make the procedure impractical for areawide emission inventory purposes.

The procedure described below was developed specifically for areawide emission inventory purposes. Since parking facilities are evaluated individually in this procedure, it would also be useful for evaluating single parking facilities. The following discussion consists of three major sections. The first describes the general approach and overall computation sequence. The second section presents the specific equations and data parameters used in the model. The procedure used for estimating vehicle parking activity is described in the third section.

Basic Approach

The parking emissions model has been structured to link a parking facility data file to a calculation procedure which uses EPA's MOBILE 1 computer program to calculate vehicle emission rates. Parking facilities are processed one at a time. Vehicle activity at each parking facility is analyzed on an hourly basis. Several categories of parking activity are considered in the model: residential parking (home-based vehicle trips), on-street parking in the downtown area (mostly metered parking), off-street covered or open parking lots, and parking garages.

Parking Facility Data Files. Two types of parking facility data files were created. The Boise area traffic model was used to generate a data file for home-based vehicle trips (residential parking). This data file contains a single entry for each traffic zone. A special data file had to be created for the remaining on- and off-street parking facilities. This was accomplished by using existing parking survey data for the downtown area and by conducting special parking surveys in other portions of the Boise metropolitan area.

Each parking facility was coded as to type, location, number of parking spaces, and general land uses served. The location coding was based on the highway links and traffic zones incorporated into the Boise area traffic model. The special parking surveys were focused on major roadways and commercial centers in the Boise area. While the result was less than 100 percent coverage of all off-street parking in the Boise area, coverage is certainly greater than 80 percent. Figure 1 shows the approximate geographic coverage of the resulting parking facility data file.

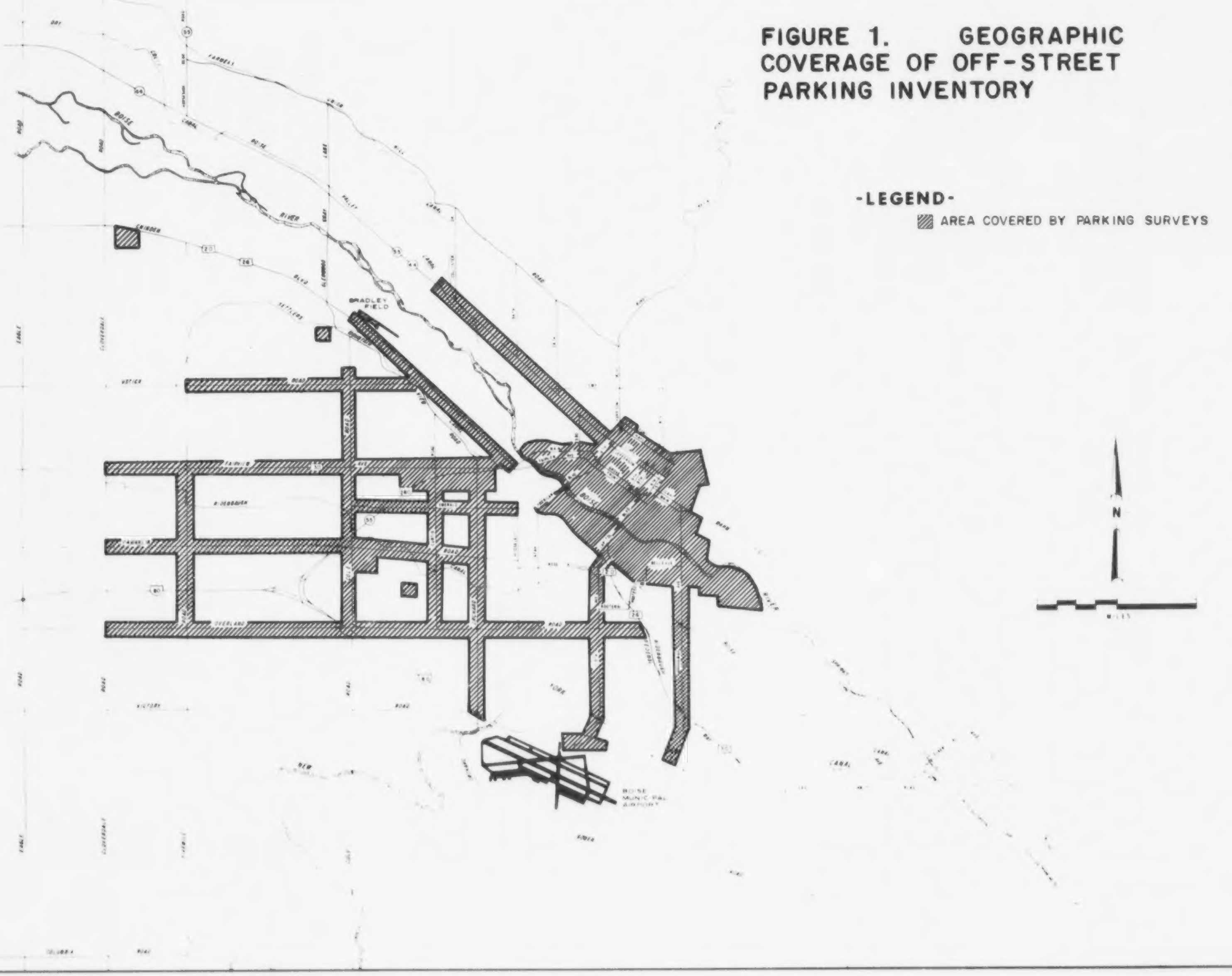
The initial on- and off-street data file represented 1980 conditions. City and county permit files were used to identify major parking lots constructed between 1977 and 1980. A 1977 data file was created by removing these facilities from the 1980 data base. Data files for future conditions were created in several steps. A "forecast base" inventory was created from the 1980 data file by deleting those parking facilities which will be removed during construction of the Boise Redevelopment Agency's City Center Project. Four additional parking lots expected to be affected by other downtown redevelopment were also deleted.

Forecasts of future parking facilities were made for two time periods: 1980-1987 and 1987-2000. These were based largely on employment projections contained in the population and employment forecasts used by APA. These forecasts (APA 1978) are broken down by traffic zone for 5-year intervals from 1975-2000. A 1987 employment forecast was interpolated from the 1985 and 1990 data. For each traffic zone the percent increase in employment (1980-1987 and 1987-2000) was used to derive a first estimate of new parking spaces. These spaces were allocated to various types and sizes of parking lots based on three factors: the 1980 parking inventory, the specific employment categories predicted by the employment forecast, and the predicted locations of future neighborhood and community shopping centers (from the employment forecast report).

The resulting forecasts were then adjusted to ensure that they reflected several major construction projects expected during the 1980-1987 time period. These major projects included the City Center project, expansion of the Hewlett-Packard facility, expansion of the M-K development, parking lot expansion at the airport, and several shopping center projects identified by city and county staff but not reflected in the 1978 population and employment forecasts.

The City Center project was treated as two separate projects: a downtown shopping and office mall project and a separate auditorium project. Parking for the mall project was treated as a subterranean parking lot (1,414 spaces) and two parking garages (5 levels with 1,110 spaces and 5 levels with 331 spaces). The auditorium parking was considered as a 4-level, 600-space garage.

FIGURE 1. GEOGRAPHIC COVERAGE OF OFF-STREET PARKING INVENTORY


-LEGEND-
▨ AREA COVERED BY PARKING SURVEYS
N
MILES
BRADLEY FIELD
BOISE MUNICIPAL AIRPORT
BOISE
RIVER
CANAL
OVERLAND
ROAD
EAGLE
CLOVERDALE
VICTORY
USTICK
COLUMBIA
BLVD

Projections of future residential parking activity were compiled from the home-based vehicle trips generated by the Boise area traffic model.

General Calculation Procedure. As noted above, the parking model evaluates hourly vehicle movements within individual parking facilities. Within each parking facility, available spaces are allocated to one of three parking duration categories: short-term parking (less than 1 hour), intermediate-term parking (1 hour or more but less than 4 hours), and long-term parking (4 hours or more). This parking duration split was made to facilitate determination of vehicle operating mode parameters required for use of the MOBILE 1 program.

Twenty groups of land use types were defined for categorizing parking facility usage patterns. Hourly entrance and exit movement patterns were defined for each parking duration category for each land use group. By assuming a hypothetical 100 spaces, it was possible to define these movement patterns as a percentage of available spaces. Depending on assumed parking duration, these movement patterns were developed on 15-minute, 30-minute, or 1-hour time increments.

The parking model performs separate analyses of hourly entrance and exit movements for spaces associated with each parking duration category. Each vehicle movement is treated as two components: vehicle travel to or from a parking space, and an idle emissions adjustment to correct for insufficient or excessive vehicle idling built into the basic MOBILE 1 emission rates.

Travel Component. Parking lots and garages do not fill in any precise sequence unless entering vehicles are directed to specific parking spaces. In general, drivers show a variety of preferences in terms of available spaces -- nearest empty space, close to an exit, close to the expected return route, etc. Once a facility has substantially filled and starts experiencing turnover of occupied spaces, the precise location of vacant spaces is not easy to predict. Thus, vehicle travel inside the facility can be reasonably estimated in terms of a weighted average travel distance between the facility entrance and the parking spaces. Since the movement of exiting vehicles is largely determined by where the entering vehicle parks, it is simplest to discuss basic procedures in terms of entering vehicles.

It is clearly impractical to calculate a weighted average travel distance specific to each parking facility in an areawide inventory. The obvious alternative is to relate this distance to parking facility area. The simplest case would be a small parking lot with one aisle. The average travel distance in this case would be one-half the length of the lot. For a square lot, this would be one-half the square root of the parking lot area. Extending this logic, the average travel path distance should be some value times the square root of parking facility area.

Appropriate coefficient values for calculating average travel path distance were developed from detailed analyses of a 4-level parking garage in Sacramento, California and the proposed underground parking facility for the Boise City Center project. The Sacramento garage was used because site plans for several parking garages in Boise could not be readily located. Several test cases were developed from each set of plans. Each level of the Sacramento garage was evaluated as if it was a surface lot. In addition, the Sacramento garage was evaluated as 2-, 3-, and 4-level structures. The underground lot for the Boise City Center project was analyzed in its entirety and as several subsections.

The basic procedure used for each test case was to outline a "standardized travel path" from each facility entrance to each parking aisle or row. A deliberate effort was made to establish reasonable but not necessarily "shortest distance" travel paths. The average travel path distance for vehicles parking in each row or aisle was calculated as a fixed distance from the entrance to the head of the parking aisle plus one-half the length of the parking aisle. The average travel path distance for vehicles parking in the lot (or on any garage level) was then determined by weighting these standard travel path distances by the number of parking spaces served.

Test case results are presented in Tables 7 and 8. These results were used as guides in developing default parameter values for the parking emissions model. Separate default coefficients were established for small lots ($\leq$100 spaces), intermediate lots (101-1,000 spaces), large lots (>1,000 spaces), and multiple-level garages.

To account for vehicle travel while searching for a parking space, average travel distances for entering vehicles were assumed to be 30 percent greater than the average travel path distance calculated above. The average travel path distance was used for exiting movements.

Default values of gross area per parking space were established for all parking garages and each size category of surface lots, thus minimizing facility-specific data requirements.

Table 7. Parameter Values for Surface Lot Test Case Analyses (Distances in Feet; Areas in Square Feet)

Facility Description	Spaces	Area	Area Per Space	Average Travel Path Distance	F Value[1]
Sacramento Garage, Level 1	215	88,912	414	350	1.174
Sacramento Garage, Level 2	230	93,569	407	356	1.164
Sacramento Garage, Level 3	204	82,984	407	325	1.128
Sacramento Garage, Level 4	116	42,858	369	172	0.831
BRA Facility, Subterranean Level, Grove & Capitol Entrance	1,445	644,818	446	1,012	1.260
South Section, BRA Facility Entrance Opposite Grove St.	841	331,680	394	690	1.198
South Section, BRA Facility, Front St. Entrance	841	331,680	394	615	1.068
South Section, BRA Facility, Both Entrances Averaged	841	331,680	394	653	1.133
Middle Section, BRA Facility	509	206,774	406	455	1.001

NOTES:

BRA = Boise Redevelopment Agency.

[1] Based on test case equation: $D = F\sqrt{area}$; where D = average travel path distance and F = coefficient value.

Table 8. Parking Garage Evaluation Assuming 2, 3, and 4 Levels
With a Single Entrance on the First Level
(Distances in Feet; Areas in Square Feet)

Number of Garage Levels	Spaces	Area	Area Per Space	Average Ramp Distance[1]	Within Level Travel[1]	Total Travel Path[1]	F Value[2]
Two Levels	445	182,481	410	261.0	353.1	614.1	1.438
Three Levels	649	265,465	409	518.4	344.3	862.7	1.674
Four Levels	765	308,323	403	690.8	318.1	1,008.9	1.817

NOTES:

[1] Weighted average according to parking spaces on component garage levels.

[2] Based on test case equation: $D = F \sqrt{area}$; where D = total travel path length and F = coefficient value.

MOBILE 1 emission rates are used to estimate emissions from vehicle travel within a parking facility. A uniform vehicle mix was used for all parking facilities and all hours. For the Boise application, temperature inputs to MOBILE 1 vary by hour (0°-20°F range). Vehicle speeds of 5, 7, and 10 mph were assigned as a function of facility size. Hourly operating mode parameters (catalyst and noncatalyst vehicle cold starts and catalyst vehicle hot starts) were established separately for entering and exiting vehicles for each parking duration category. Catalyst and noncatalyst vehicle cold start percentages for vehicles using short-term parking spaces reflect the extent to which trips in the Boise area are completed while still in a cold start mode.

Idling Adjustment. The idling adjustment step introduced significant complexity into the parking emissions model. As applied in Boise (or any other cold weather area), it accounts for a substantial fraction of total parking emissions.

The initial step in the idle adjustment procedure required setting a maximum on the amount of idling time for entering vehicle movements, and a minimum for exiting vehicle movements. Home-based vehicle trips and on-street parking were treated as exiting vehicle movements only. Entering and exiting idle threshold values (seconds of idling) were set separately for garages, surface lots, on-street parking, and home-based trips.

The amount of idling emissions built into MOBILE 1 varies as a function of vehicle speed. At low speeds, the MOBILE 1 emission rates assume that idling accounts for 30-45 percent of vehicle operating time (Table 9).

In analyzing the hourly entering and exiting vehicle movements at a parking facility, the model calculates the seconds of idling accounted for by the MOBILE 1 emission rates. This value is compared to the appropriate idle threshold value to determine an appropriate idle adjustment factor. For entering vehicle movements, the idle adjustment factor represents any excessive idling inherent in the MOBILE 1 rates (idling built into MOBILE 1 > entering vehicle idle threshold value). For exiting vehicle movements, the idle adjustment factor represents insufficient idling inherent in the MOBILE 1 rates (idling built into MOBILE 1 < exiting vehicle idle threshold value).

The idling emission rates calculated by the MOBILE 1 program are not an adequate basis for analyzing idle emissions in a parking lot. The MOBILE 1 idle emission rates represent a hot stabilized operating mode. Much vehicle activity in a parking facility, however, will occur in a

Table 9. Percent Idling (Time Basis) Incorporated Into MOBILE 1 Emission Rates At Various Speeds

Nominal Speed (mph)	Percent Idle	Nominal Speed (mph)	Percent Idle	Nominal Speed (mph)	Percent Idle
5	45.78	26	12.97	46	2.37
6	43.23	27	12.32	47	2.39
7	40.67	28	11.67	48	2.40
8	38.11	29	11.02	49	2.42
9	35.55	30	10.37	50	2.44
10	32.99	31	9.70	51	2.43
11	31.06	32	9.02	52	2.32
12	29.64	33	8.34	53	2.21
13	28.22	34	7.67	54	2.10
14	26.80	35	6.99	55	1.99
15	25.38	36	6.30	56	1.88
16	23.96	37	5.62	57	1.77
17	22.48	38	4.93	58	1.66
18	21.00	39	4.24	59	1.55
19	19.53	40	3.55	60	1.44
20	18.05	41	3.05		
21	16.75	42	2.88		
22	15.97	43	2.72		
23	15.20	44	2.56		
24	14.43	45	2.40		
25	13.66				

DATA SOURCE:

Based on linear interpolation of percent time at idle vs. (actual) average speed given in Table 5-2 of Smith and Aldrich 1977.

cold start or hot start mode (all exiting movements plus entering movements for vehicles reaching the facility after a short trip duration).

Hot start idle emission rates were assumed to be the same as the MOBILE 1 hot stabilized idle rate. Cold start idle emission rates were estimated from 100 percent cold start (PCCO = PCCC = 100.0; PCHS = 0.0) running emissions at 5 mph. The 5 mph cold start emission rates from MOBILE 1 were converted to a grams per minute basis and used as a cold start idle rate (generally about 2.5-3.5 times the hot stabilized idle rate). A weighted cold/hot idle emission rate factor was calculated from the cold start and hot stabilized idle rates, weighting these components according to the fraction of vehicles entering or exiting the facility in a cold start mode.

The fraction of vehicles entering or exiting in a cold start mode was itself calculated as a weighted average of the catalyst and noncatalyst cold start percentages for the hour being analyzed.

Total Emissions. Emissions from entering and exiting vehicles were computed separately as the sums of travel component emissions and the appropriate idle adjustment emissions. For entering vehicles, the idle adjustment was either zero or a negative value. For exiting vehicles, the idle adjustment was either zero or a positive value. Most parking facilities did not require any entering vehicle idle adjustment, but did require an idle adjustment for exiting vehicles.

Emissions from on-street parking and home-based trips were treated as idling emissions during vehicle warm-up. This was accomplished by using the exiting vehicle idle adjustment computation.

Equations and Default Parameter Values

Variables used in the parking emissions model are listed in Table 10. The designation of these variables in the computer program varies somewhat from the listing in Table 10. For example, MNX is used in the program for both M_n and M_x, with internal program flags distinguishing which variable is being used at any point in the calculation. Table 11 indicates equivalencies between variables as designated in the computer program and as designated in Table 10. The computer program does not print subscripts, thus producing some obvious equivalencies which are not listed.

Table 10. Parameters Used in the Parking Emissions Model

Parameter	Definition
A	Gross area of parking facility (square feet).
B	Gross area per parking space (square feet per space).
C	Percent of the vehicle fleet which is equipped with catalytic converters (percent).
D	Standardized travel path length (feet).
D_n	Average travel distance for entering vehicles (feet).
D_x	Average travel distance for exiting vehicles (feet).
D_z	Generalized expression for D_n and D_x.
E_c	MOBILE 1 emission rate for vehicles traveling at 5 mph under 100 percent cold start conditions [PCCO = PCCC = 100.0; PCHS = 0.0]; (grams per mile).
E_{jz}	MOBILE 1 emission rate for the travel component of vehicle activity in a parking facility (grams per mile).
F	Coefficient in the standardized travel path length equation.
F'	Coefficient in the standardized travel path length equation; applicable only to multiple level parking garages.
G	Parking facility type code.
H	Vehicle idle time fraction for MOBILE 1 emission rates.
I_c	Cold start idle emission rate derived from E_c (grams per minute).
I_r	Hot stabilized idle emission rate from MOBILE 1 (grams per minute).
I_{jz}	Weighted hot/cold idle emission rate derived from I_c and I_r (grams per minute).
K_{jz}	Idle adjustment factor as used in the computer program (minutes of idling per hour).
K'_{jz}	Idle adjustment factor as used in calculator version of the model (grams per vehicle).
L	Number of parking levels in an off-street parking facility.
M_n	Idle adjustment threshold value for entering vehicles (seconds per vehicle).
M_x	Idle adjustment threshold value for exiting vehicles (seconds per vehicle).
M_z	Generalized expression for M_n and M_x.
P	Total number of parking spaces in a facility.
P_s	Number of parking spaces in a facility which are used for short-term parking (duration <1 hour).
P_i	Number of parking spaces in a facility which are used for intermediate-term parking (1 hour $\leq$ duration <4 hours)
P_l	Number of parking spaces in a facility which are used for long-term parking (duration ≥ 4 hours).
P_j	Generalized expression for P_s, P_i, and P_l.
$PCCC_{jz}$	Percent of vehicle activity by catalyst-equipped vehicles which occurs in a cold start operating mode (percent of vehicle trips). Note that this variable is treated on a vehicle trip basis, not a VMT basis, when applied to the parking emissions program.
$PCCO_{jz}$	Percent of vehicle activity by noncatalyst vehicles which occurs in a cold start operating mode (percent of vehicle trips). Note that this variable is treated on a vehicle trip basis, not a VMT basis, when applied to the parking emissions program.
Q_{jz}	Emissions from vehicle activity in parking facilities during the time period analyzed (grams). The basic calculation is structured for hourly analyses.
S	Average vehicle speed in a parking facility (mph).
T'	Coefficient in the equation used to calculate the vehicle idling time accounted for in MOBILE 1 emission rates (seconds of idling per foot of travel).
T_n	MOBILE 1 emission rate idle time for vehicles entering a parking facility (seconds).
T_x	MOBILE 1 emission rate idle time for vehicles exiting a parking facility (seconds).
T_z	Generalized expression for T_n and T_x.
U_z	Coefficient in average travel distance equation.
V_{jz}	Number of vehicle movements during hour being analyzed (vehicles per hour).
W_{jz}	Fleet-averaged percent of vehicle movements occurring in a cold start operating mode (percent of vehicle trips).
Y_{jz}	Fraction or percent of spaces allocated to a parking duration category in a parking facility experiencing an entering or exiting vehicle movement during the hour under analysis; specified separately for each parking duration and movement direction combination. The computer program specifies this parameter as a percentage value while the calculator program specifies this parameter as a decimal fraction.
Subscript j	Subscript used to designate parking duration category: s = short-term, i = intermediate-term, and l = long-term.
Subscript z	Subscript used to designate vehicle movement direction: n = entering vehicle, x = exiting vehicle.

Reproduced from
best available copy.

Table 11. Parameter Designations Used in the Computer Program

Computer Program Designation of Parameter	Equivalent Designation from Table
BTAB	B
DNX	D_z
EC	I_c
FTAB	F
IDLWTD	I_r
IJNX	I_{jz}
KJNX	K_{jz}
MNX	M_z
Q	Q_{jz}
RP	P
RUNEM	E_{jz}
SP1	S
STAB	S
TFAC	T'
TNX	T_z
UTAB	U_z
VJNX	V_{jz}
WJNORX	W_{jz}
WJNX	C
YSNX	Y_{jz}

Note: Additional equivalencies are defined in the computer program or are obvious (i.e., PS = P_s).

The equations used for the parking emissions program are shown in Table 12. Two formats for calculating Q_{jz} are shown. The format using K_{jz} has been used in the computer program. The format using K'_{jz} has been used in a programmable calculator version of the model. The programmable calculator version was used to verify that the computer program was functioning properly.

Use of the parking model in Boise involved default values for most parameters. These are shown in a series of tables discussed below. Application of this model in other locations would require different values for some of these parameters. The computer program installed in Boise is designed to allow substitution of different parameter values during any individual program run without deleting the basic default values.

Table 13 presents default values for those parameters which are a function of facility size and type. Four facility types were defined for the parking facility inventory and identified by facility type code (G):

- Home-based trips from the Boise traffic model (converted from person trips to vehicle trips), G = 0.
- On-street parking, G = 1.
- Off-street single level open or covered parking lots, G = 2.
- Off-street multiple level parking garages, $G \geq 3$.

A default hourly temperature curve was established in consultation with the Idaho Air Quality Bureau (Table 14). The MOBILE 1 program does not accept temperatures below 0°F. The adopted temperature curve is considered representative of a cold winter day in Boise, but is not based on any statistical analysis of daily temperature records.

The MOBILE 1 program requires the user to input three parameters defining the operating mode mix for light and medium duty vehicles in the vehicle fleet being evaluated. Light and medium duty vehicles are classified into those with and those without catalytic converters. Three operating modes are recognized in MOBILE 1: cold start, hot start, and hot stabilized. In any vehicle fleet, catalyst and noncatalyst vehicles will exhibit similar frequencies of hot stabilized operation. Catalyst vehicles, however, will usually show a higher frequency of cold start and a lower frequency of hot start operation than noncatalyst vehicles.

Table 12. Equations in the Parking Emissions Model

Equation	Conditions
$P = P_s + P_i + P_l$	
$A = (B)(P)$	
$G = L + 1$	Only for off-street parking facilities
$F' = 1 + (F)(G - 1)$	Only for $G \geq 3$
$D = F\sqrt{A}$	When $G \leq 2$
$D = F'\sqrt{A}$	When $G \geq 3$
$D_z = (U_z)(D)$	
$T' = \frac{(H)(3{,}600)}{(S)(5{,}280)}$	
$T_z = (D_z)(T')$	
$V_{jz} = (P_j)(Y_{jz})$	When Y_{jz} specified as decimal fractions
$V_{jz} = \frac{(P_j)(Y_{jz})}{100}$	When Y_{jz} specified as percentage values
$W_{jz} = \frac{(C)(PCCC_{jz}) + (100 - C)(PCCO_{jz})}{10{,}000}$	
$I_c = \frac{E_c}{12}$	
$I_{jz} = (W_{jz})(I_c) + (1 - W_{jz})(I_r)$	
$K_{jz} = 0$	When $M_n \geq T_n$ or $M_x \leq T_x$
$K_{jz} = \frac{(M_z - T_z)(V_{jz})}{60}$	When $M_n \leq T_n$ or $M_x \geq T_x$
$K'_{jz} = 0$	When $M_n \geq T_n$ or $M_x \leq T_x$
$K'_{jz} = \frac{(M_z - T_z)(I_{jz})}{60}$	When $M_n \leq T_n$ or $M_x \geq T_x$
$Q_{jz} = \frac{(E_{jz})(D_z)(V_{jz})}{5{,}280} + (K_{jz})(I_{jz})$	
$Q_{jz} = \left[\frac{(E_{jz})(D_z)}{5{,}280} + (K'_{jz})\right][V_{jz}]$	

Note: Parameters defined in Table 10.

Table 13. Parameter Values Defined as a Function of Total Parking Spaces and/or Parking Facility Type

Parameter (units)	Facility Type Code[1] (G)	Total Spaces (P)	Default Parameter Value
B (square feet per space)	$G \leq 1$	NA	$B = 0$
	$G = 2$	$P < 100$ $101 < P < 1{,}000$ $P \geq 1{,}001$	$B = 400$ $B = 425$ $B = 450$
	$G \geq 3$	All	$B = 425$
F (dimensionless)	$G < 1$	NA	$F = 0$
	$G = 2$	$P < 100$ $101 < P < 1{,}000$ $P \geq 1{,}001$	$F = 0.8$ $F = 1.15$ $F = 1.3$
	$G \geq 3$	All	$F = 0.21$
H (dimensionless)	$G \leq 1$	NA	$H = 0$
	$G \geq 2$	$P < 100$ $101 < P < 1{,}000$ $P \geq 1{,}000$	$H = 0.4578$ $H = 0.4067$ $H = 0.3299$
M_n (seconds per vehicle)	$G \leq 1$	NA	$M_n = 0$
	$G = 2$	All	$M_n = 30$
	$G \geq 3$	All	$M_n = 45$
M_x (seconds per vehicle)	$G = 0$	NA	$M_x = 60$
	$G = 1$	NA	$M_x = 25$
	$G = 2$	All	$M_x = 40$
	$G \geq 3$	All	$M_x = 60$
S (miles per hour)	$G \leq 1$	NA	$S = 0$
	$G \geq 2$	$P < 100$ $101 < P < 1{,}000$ $P \geq 1{,}001$	$S = 5$ $S = 7$ $S = 10$
U_n (dimensionless)	$G \leq 1$	NA	$U_n = 0$
	$G \geq 2$	All	$U_n = 1.0$
U_x (dimensionless)	$G \leq 1$	NA	$U_x = 0$
	$G \geq 2$	All	$U_x = 1.3$

Notes:

NA = not applicable

[1] $G = 0$ For home-based trips.
$G = 1$ For on-street parking.
$G = 2$ For single level surface or covered off-street parking lots.
$G = L + 1$ For off-street multiple level parking garages. L = Number of levels in the facility.

Table 14. Default Temperature Pattern for the Boise Area

Clock Hour	Temperature (°F)	Clock Hour	Temperature (°F)
1	0	13	16
2	0	14	18
3	0	15	20
4	0	16	18
5	0	17	16
6	0	18	14
7	2	19	12
8	6	20	10
9	8	21	8
10	10	22	6
11	12	23	4
12	14	24	2

Notes: Clock hours are designated by the end of the hour. Thus, hour 8 = 7:00 a.m. to 8:00 a.m. and hour 17 = 4:00 p.m. to 5:00 p.m.

The MOBILE 1 program assumes identical hot stabilized operating mode frequencies for both catalyst and noncatalyst vehicles. The four cold start and hot start operating mode frequencies can be determined from any three of the four values. The MOBILE 1 program uses:

- o Noncatalyst vehicle cold start activity (PCCO).
- o Catalyst vehicle hot start activity (PCHS).
- o Catalyst vehicle cold start activity (PCCC).

For the parking emissions program, these three parameters must be defined separately for vehicles entering or exiting parking spaces for each of the three parking duration categories. The operating mode of vehicles exiting from intermediate or long-term spaces is automatically determined by the time periods used to define these parking durations. The operating mode for vehicles entering a parking facility or exiting after a short-term parking duration is not so easily determined.

The traffic model for Boise was used to determine the frequency distribution of trip durations. The short average trip length in Boise results in about 34 percent of all vehicles completing a trip while still in a cold or hot start mode. A hand computation of data from the parking facility inventory indicated that about 35 percent of Boise area trips would be started after an intermediate term parking duration, thus producing a similar differential between catalyst and noncatalyst cold start frequencies. A 20 percentage point differential was eventually used because of uncertainty regarding the hand tabulation of parking inventory data. Table 15 presents the hourly catalyst and noncatalyst vehicle operating mode parameters used in the parking emissions model.

While the MOBILE 1 program requires a distinction between catalyst and noncatalyst vehicle operating modes, the parking emissions model also requires a calculation of the fleet-averaged cold start percent. This calculation requires an estimate of the percent of the overall vehicle fleet which will be equipped with catalytic converters (Table 16).

Default Vehicle Movement Patterns

Coding of the parking facility data file required several items of information:

- o A map code for reference to the inventory field maps and notes.

Table 15. Default Operating Mode Parameters (%)

HR-->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PCCONS	20.	20.	20.	20.	20.	20.	20.	10.	10.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
PCCONI	20.	20.	20.	20.	20.	20.	20.	10.	10.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
PCCONL	15.	15.	15.	15.	15.	15.	15.	15.	15.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
PCHSNS	10.	10.	10.	10.	10.	10.	10.	5.	5.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
PCHSNI	10.	10.	10.	10.	10.	10.	10.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	10.	10.	10.	10.	10.	10.
PCHSNL	5.	5.	5.	5.	5.	5.	5.	5.	5.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
PCCCNS	40.	40.	40.	40.	40.	40.	40.	30.	30.	35.	35.	35.	35.	35.	35.	35.	35.	35.	40.	40.	40.	40.	40.	40.
PCCCNI	40.	40.	40.	40.	40.	40.	40.	30.	30.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
PCCCNL	20.	20.	20.	20.	20.	20.	20.	20.	20.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
PCCOXS	20.	20.	20.	20.	20.	20.	20.	10.	10.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
PCCOXI	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PCCOXL	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
PCHSXS	10.	10.	10.	10.	10.	10.	10.	5.	5.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
PCHSXI	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PCHSXL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PCCCXS	40.	40.	40.	40.	40.	40.	40.	30.	30.	35.	35.	35.	35.	35.	35.	35.	35.	35.	40.	40.	40.	40.	40.	40.
PCCCXI	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
PCCCXL	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.

NOTES:

This table was prepared from a computer printout of the default vehicle operating mode data.

The computer program identifies the data sets using a $PCCO_{zj}$, $PCHS_{zj}$, $PCCC_{zj}$, notation format; z = entering (n) or exiting (x); j = short-term parking (s), intermediate-term parking (i), or long-term parking (l).

Table 16. Percent of Boise Vehicle Fleet Expected to be Equipped With Catalytic Converters

Calendar Year	Default Value of C (%)
1974	0.0
1975	6.4
1976	18.5
1977	29.8
1978	37.9
1979	47.5
1980	57.6
1981	66.3
1982	72.4
1983	77.8
1984	82.5
1985	86.0
1986	89.0
1987	91.5
1988	93.8
1989	95.4
1990	96.5
1991	97.4
1992	97.9
1993	98.4
1994	98.8
1995	98.9
1996	98.9
1997	99.0
1998	99.0
1999	99.0

NOTES:

Based on default vehicle fleet mix, Boise area vehicle age distribution, MOBILE 1 default age-dependent annual mileage distributions, and MOBILE 1 assumptions for catalyst equipment rates by vehicle type.

Default vehicle fleet mix:

Light Duty Autos = 71.6%
Light Duty Trucks = 24.6%
Medium Duty Trucks = 2.8%
Heavy Duty Gasoline Trucks = 0.0%
Heavy Duty Diesel Trucks = 0.0%
Motorcycles = 1.0%

- The traffic zone in which the parking facility was located.

- The highway link designations for any roadways in the Boise area traffic model which provided direct access to the parking facility.

- The facility type code.

- An allocation of the total parking spaces in the facility to the three parking duration categories.

- Identification of an "activity index code" for the spaces in each parking duration category.

Typical parking duration splits and activity index assignments are indicated in Table 17. While most parking facilities in the inventory were coded according to the guidance in Table 17, several exceptions were made to reflect special conditions. The distribution of total parking spaces among parking duration categories was completely independent of activity index code assignment.

The activity index codes were used internally in the parking emissions model to identify appropriate sets of hourly vehicle entrance and exit percentages. The general characteristics of the various entrance and exit patterns are outlined in Tables 18 through 20. As indicated in these tables, the computer program was structured to take up to 75 sets of hourly entrance and exit percentages. In actual application, only 49 sets were coded into the program as default data. Thus, ample opportunity remains to establish facility-specific movement patterns for parking facilities of special concern.

The 49 default activity patterns are identified in Table 21. The values in this table represent vehicle movements as a percent of parking spaces assigned to the particular parking duration category. Values in excess of 100 percent are possible for short-term parking. These movement patterns were developed by Jones & Stokes Associates staff. They are based largely on individual judgment as to reasonable patterns. Input regarding activity periods for several land use types was derived from newspaper and telephone book advertisements. Target values for average occupancy rates were based on parking survey data and discussions with Ada Planning Association staff.

Table 17. Default Guidance for Parking Duration Category and Parking Activity Index Assignments

General Land Use Groups (Typical Examples)	Typical Assignment of Parking Duration Categories			Typical Activity Index Assignments		
	P_s (%)	P_i (%)	P_l (%)	Y_s	Y_i	Y_l
Office, school	5	20	75	6	32	58
Financial institution	90	5	5	9	37	59
Industrial, wholesale, warehousing	0	30	70	--	31	58
Building supplies	65	30	5	8	35	59
Medical office	5	85	10	7	34	58
Hospital	10	40	50	2	28	52
Bus station, airport	20	10	70	1	26	51
Grocery, convenience store	95	5	0	4	29	--
Cafe-type restaurant	25	70	5	3	29	53
Restaurant	25	70	5	15	43	62
Fast food	100	0	0	5	--	--
Theater	0	90	10	--	42	61
Shopping center	30	60	10	10	38	56
Motel, bar, auto dealer, furniture, church, BSU campus	30	65	5	14	30	54
Auto parts, car wash, travel agency, rental agency, copy shop	85	10	5	11	39	60
Laundry, pest control	30	65	5	13	41	60
Real estate, miscellaneous small businesses and retail stores	50	45	5	12	40	60
Unrestricted public lots in CBD	-------- Variable --------			3	29	56
On-street parking	-------- Variable --------			3 or 12	29	
Home-based trips	0	50	50	--	44	63

NOTES: Parking duration assignments are % of total spaces; P_s = short-term spaces; P_i = intermediate-term spaces; P_l = long-term spaces. Y_s index codes relate to short-term spaces; Y_i index codes relate to intermediate-term spaces; Y_l index codes relate to long-term parking.

Table 18. Characteristics of Short-Term Parking Movement Patterns

Short-Term Activity Index (Y_s)	Activity Period (Clock Hours)	Parking Duration (Hours)	Daily Turnovers Per Space	Average Occupancy Factor (%)	Peak Occupancy Factor (%)
1	1-24	0.50	21.13	40-64	76-100
2	1-24	0.75	18.25	42-52	90-100
3	7-21	0.75	11.25	56.2	100
4	8-21	0.50	16.20	57.9	100
5	8-23	0.50	15.35	48.1	100
6	9-17	0.50	3.35	18.5	55
7	9-17	0.75	6.90	57.5	100
8	9-18	0.50	7.55	37.8	50
9	9-18	0.50	9.15	46.0	80
10	9-21	0.75	8.90	51.3	75
11	10-17	0.50	5.90	36.9	60
12	10-17	0.50	9.30	58.1	90
13	10-17	0.75	6.00	56.3	90
14	10-21	0.75	8.00	50.9	90
15	12-24	0.75	9.10	52.3	95
16	9-21	0.75	11.45	66.1	85
17					
18					
19					
20					
21					
22					
23					
24					
25					

NOTES:

Index codes 17-25 not yet used.

Clock hour designations (1-24) indicate end of designated hour; for example, hour 8 = 7 a.m.-8 a.m.

Each turnover involves both an entering and an exiting vehicle movement.

The range of occupancy factors for activity patterns 1 and 2 reflects the possibility that the lot is never completely empty.

Table 19. Characteristics of Intermediate-Term Parking Movement Patterns

Intermediate-Term Activity Index (Y_i)	Activity Period (Clock Hours)	Parking Duration (Hours)	Daily Turnovers Per Space	Average Occupancy Factor (%)	Peak Occupancy Factor (%)
26	1-24	3.5	5.45	44.5	100
27	1-24	3.0	4.00	34-49	85-100
28	1-24	3.0	4.20	37.5-62.5	75-100
29	7-22	1.5	7.10	66.3	100
30	7-24	3.0	3.15	47.5	90
31	8-18	2.5	2.75	62.5	90
32	9-17	2.5	1.45	40.3	70
33	9-17	2.0	2.25	50.0	85
34	9-17	2.0	2.70	60.0	90
35	9-18	2.0	3.05	61.0	100
36	9-18	2.0	2.35	47.0	80
37	9-18	2.5	2.20	55.0	100
38	9-21	2.5	3.10	57.6	90
39	10-17	1.5	2.55	47.8	85
40	10-17	1.5	3.30	61.7	100
41	10-18	2.0	2.30	51.1	80
42	11-24	3.0	2.75	58.9	100
43	12-24	2.5	2.95	56.7	100
44	11-20	NA	0.50	NA	NA
45	9-21	2.5	3.35	63.9	100
46					
47					
48					
49					
50					

NOTES:

Index codes 46-50 not yet used.

Clock hour designations (1-24) indicate end of designated hour; for example, hour 8 = 7 a.m.-8 a.m.

Each turnover involves both an entering and an exiting vehicle movement.

The range of occupancy factors for activity patterns 27 and 28 reflects the possibility that the lot is never completely empty.

Activity pattern 44 is applied to home-based trips, not to discrete parking lots.

Table 20. Characteristics of Long-Term Parking Movement Patterns

Long-Term Activity Index (Y_1)	Activity Period (Clock Hours)	Parking Duration (Hours)	Daily Turnovers Per Space	Average Occupancy Factor (%)	Peak Occupancy Factor (%)
51	1-24	Mixed; ave. = 12.0	2.15	31.5-56.5	75-100
52	1-24	8.0	2.70	90.0	90
53	6-22	8.0	1.92	90.0	96
54	6-24	8.0	2.00	84.2	100
55	6-24	8.0	2.00	84.2	100
56	8-22	Mixed; ave. = 6.2	1.85	76.0	100
57	8-22	8.0	1.00	53.3	100
58	8-18	9.0	1.00	81.8	100
59	8-19	8.0	1.00	66.7	100
60	9-18	9.0	1.00	90.0	100
61	10-02	8.0	1.30	61.2	100
62	11-01	8.0	1.00	53.3	100
63	8-14	NA	0.50	NA	NA
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					

NOTES:

Index codes 64-75 not yet used.

Clock hour designations (1-24) indicate end of designated hours; for example, hour 8 = 7 a.m.-8 a.m.

Each turnover involves both an entering and an exiting vehicle movement.

The range of occupancy factors for activity pattern 51 reflects the possibility that the lot is never completely empty.

Activity pattern 63 is applied to home-based trips, not to discrete parking lots.

Table 21. Default Parking Movement Patterns

HR-->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
YSNX 1	20.	14.	8.	8.	8.	25.	60.	100.	120.	100.	120.	140.	160.	150.	135.	120.	150.	160.	135.	120.	100.	80.	40.	40.
	30.	20.	8.	8.	8.	14.	40.	80.	115.	110.	110.	130.	150.	160.	140.	125.	130.	160.	150.	125.	110.	90.	60.	40.
YSNX 2	35.	20.	20.	20.	20.	40.	40.	60.	65.	80.	100.	85.	60.	80.	115.	120.	140.	140.	120.	140.	115.	90.	70.	50.
	45.	30.	20.	20.	20.	25.	40.	45.	60.	70.	85.	100.	75.	60.	90.	120.	125.	140.	135.	125.	135.	110.	85.	65.
YSNX 3	0.	0.	0.	0.	0.	0.	80.	120.	100.	50.	45.	105.	130.	85.	45.	40.	55.	90.	95.	75.	10.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	15.	90.	125.	85.	45.	55.	120.	120.	75.	40.	40.	65.	95.	90.	65.	0.	0.	0.
YSNX 4	0.	0.	0.	0.	0.	0.	0.	20.	30.	70.	120.	140.	135.	130.	160.	175.	160.	190.	145.	115.	30.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	10.	20.	45.	100.	135.	140.	125.	150.	170.	165.	170.	175.	130.	85.	0.	0.	0.
YSNX 5	0.	0.	0.	0.	0.	0.	0.	35.	50.	40.	75.	120.	190.	155.	100.	110.	90.	125.	135.	115.	85.	85.	25.	0.
	0.	0.	0.	0.	0.	0.	0.	10.	55.	40.	55.	95.	165.	170.	130.	100.	105.	95.	140.	125.	100.	90.	60.	0.
YSNX 6	0.	0.	0.	0.	0.	0.	0.	0.	10.	10.	30.	25.	5.	40.	95.	95.	25.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	15.	25.	25.	10.	20.	70.	105.	65.	0.	0.	0.	0.	0.	0.	0.
YSNX 7	0.	0.	0.	0.	0.	0.	0.	0.	40.	85.	125.	100.	70.	110.	90.	65.	5.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	5.	50.	95.	130.	85.	80.	110.	65.	50.	0.	0.	0.	0.	0.	0.	0.
YSNX 8	0.	0.	0.	0.	0.	0.	0.	0.	80.	85.	65.	80.	95.	75.	70.	90.	80.	35.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	30.	95.	75.	70.	90.	85.	65.	90.	80.	75.	0.	0.	0.	0.	0.	0.
YSNX 9	0.	0.	0.	0.	0.	0.	0.	0.	25.	55.	80.	110.	150.	125.	100.	115.	105.	50.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	10.	40.	70.	90.	130.	150.	105.	105.	110.	105.	0.	0.	0.	0.	0.	0.
YSNX 10	0.	0.	0.	0.	0.	0.	0.	0.	30.	55.	90.	90.	85.	90.	70.	75.	70.	95.	60.	70.	10.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	5.	35.	65.	95.	90.	80.	90.	70.	70.	80.	85.	65.	60.	0.	0.	0.
YSNX 11	0.	0.	0.	0.	0.	0.	0.	0.	0.	30.	70.	75.	105.	85.	100.	100.	25.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.	55.	65.	100.	95.	85.	110.	70.	0.	0.	0.	0.	0.	0.	0.
YSNX 12	0.	0.	0.	0.	0.	0.	0.	0.	0.	60.	110.	130.	170.	150.	130.	140.	40.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	85.	120.	155.	165.	130.	140.	110.	0.	0.	0.	0.	0.	0.	0.
YSNX 13	0.	0.	0.	0.	0.	0.	0.	0.	0.	35.	80.	110.	115.	85.	90.	75.	10.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.	45.	90.	115.	110.	80.	95.	60.	0.	0.	0.	0.	0.	0.	0.
YSNX 14	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	45.	70.	90.	80.	110.	105.	80.	65.	45.	75.	10.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.	30.	50.	75.	90.	85.	115.	95.	80.	45.	65.	65.	0.	0.	0.
YSNX 15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	90.	120.	80.	45.	50.	65.	95.	110.	95.	70.	50.	35.	5.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	15.	105.	115.	70.	40.	55.	70.	100.	110.	90.	65.	45.	30.
YSNX 16	0.	0.	0.	0.	0.	0.	0.	0.	45.	85.	110.	110.	105.	110.	90.	95.	90.	115.	85.	90.	15.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	5.	60.	90.	115.	110.	100.	110.	90.	90.	100.	110.	85.	80.	0.	0.	0.
YSNX 26	10.	10.	10.	10.	10.	20.	20.	30.	40.	35.	30.	40.	40.	40.	30.	25.	20.	25.	30.	25.	15.	10.	10.	10.
	10.	10.	10.	10.	10.	10.	10.	10.	15.	20.	20.	40.	40.	30.	35.	40.	40.	35.	30.	20.	20.	30.	30.	20.

Table 21. Cont'd.

HR-->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
YSNX 27	5.	5.	5.	5.	5.	10.	15.	20.	20.	25.	25.	30.	30.	30.	35.	35.	25.	20.	20.	10.	10.	5.	5.	5.
	5.	5.	5.	5.	5.	5.	5.	5.	10.	15.	20.	20.	25.	25.	30.	30.	30.	35.	35.	25.	20.	20.	10.	10.
YSNX 28	5.	5.	5.	5.	5.	10.	10.	15.	20.	20.	30.	30.	30.	30.	30.	30.	30.	30.	25.	25.	10.	10.	5.	5.
	10.	5.	5.	5.	5.	5.	5.	5.	10.	10.	15.	20.	20.	30.	30.	30.	30.	30.	30.	30.	30.	25.	25.	10.
YSNX 29	0.	0.	0.	0.	0.	0.	40.	75.	50.	30.	35.	60.	65.	35.	35.	40.	45.	65.	65.	55.	15.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	15.	60.	65.	40.	30.	45.	75.	45.	30.	40.	40.	55.	70.	60.	40.	0.	0.
YSNX 30	0.	0.	0.	0.	0.	0.	10.	10.	10.	15.	15.	20.	30.	30.	30.	30.	30.	30.	30.	15.	10.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.	10.	10.	15.	15.	20.	30.	30.	30.	30.	30.	30.	30.	15.	10.
YSNX 31	0.	0.	0.	0.	0.	0.	0.	20.	35.	35.	35.	35.	25.	35.	35.	20.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.	30.	40.	35.	30.	30.	35.	30.	40.	0.	0.	0.	0.	0.	0.
YSNX 32	0.	0.	0.	0.	0.	0.	0.	0.	10.	25.	30.	25.	10.	30.	15.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.	15.	30.	25.	20.	20.	30.	0.	0.	0.	0.	0.	0.	0.
YSNX 33	0.	0.	0.	0.	0.	0.	0.	0.	25.	35.	40.	25.	15.	45.	40.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	35.	40.	25.	15.	45.	40.	0.	0.	0.	0.	0.	0.	0.
YSNX 34	0.	0.	0.	0.	0.	0.	0.	0.	35.	40.	45.	40.	20.	50.	40.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	35.	40.	45.	40.	20.	50.	40.	0.	0.	0.	0.	0.	0.	0.
YSNX 35	0.	0.	0.	0.	0.	0.	0.	0.	25.	25.	35.	45.	55.	40.	35.	45.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	25.	35.	45.	55.	40.	35.	45.	0.	0.	0.	0.	0.	0.
YSNX 36	0.	0.	0.	0.	0.	0.	0.	0.	15.	25.	25.	35.	45.	30.	25.	35.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	15.	25.	25.	35.	45.	30.	25.	35.	0.	0.	0.	0.	0.	0.
YSNX 37	0.	0.	0.	0.	0.	0.	0.	0.	20.	25.	30.	25.	40.	45.	25.	10.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.	20.	30.	25.	35.	45.	35.	20.	0.	0.	0.	0.	0.	0.
YSNX 38	0.	0.	0.	0.	0.	0.	0.	0.	10.	15.	30.	35.	40.	30.	25.	35.	30.	40.	20.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.	10.	25.	30.	40.	35.	30.	20.	30.	35.	40.	0.	0.	0.
YSNX 39	0.	0.	0.	0.	0.	0.	0.	0.	0.	20.	30.	45.	55.	55.	35.	15.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.	25.	35.	50.	60.	45.	30.	0.	0.	0.	0.	0.	0.	0.
YSNX 40	0.	0.	0.	0.	0.	0.	0.	0.	0.	35.	45.	55.	65.	65.	45.	20.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	15.	40.	50.	60.	70.	55.	40.	0.	0.	0.	0.	0.	0.	0.
YSNX 41	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	35.	35.	45.	30.	25.	35.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	35.	35.	45.	30.	25.	35.	0.	0.	0.	0.	0.	0.
YSNX 42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	15.	15.	20.	20.	15.	20.	35.	35.	30.	35.	35.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	15.	15.	20.	20.	15.	20.	35.	35.	30.	35.	25.
YSNX 43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	40.	45.	20.	5.	10.	25.	40.	40.	40.	25.	5.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	15.	50.	30.	15.	0.	20.	35.	40.	40.	35.	15.

Table 21. Cont'd.

HR-->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
YSNX 44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	0.	0.	0.	0.
YSNX 45	0.	0.	0.	0.	0.	0.	0.	0.	10.	20.	35.	35.	45.	35.	25.	35.	30.	45.	20.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.	15.	25.	35.	45.	40.	30.	25.	35.	40.	40.	0.	0.	0.
YSNX 51	5.	5.	0.	5.	5.	10.	15.	20.	20.	15.	15.	15.	15.	10.	10.	10.	5.	5.	5.	5.	5.	5.	5.	5.
	5.	5.	5.	5.	0.	5.	5.	5.	5.	5.	10.	10.	10.	15.	15.	15.	20.	20.	5.	10.	15.	15.	5.	5.
YSNX 52	90.	0.	0.	0.	0.	0.	0.	0.	90.	0.	0.	0.	0.	0.	0.	0.	90.	0.	0.	0.	0.	0.	0.	0.
	90.	0.	0.	0.	0.	0.	0.	0.	90.	0.	0.	0.	0.	0.	0.	0.	90.	0.	0.	0.	0.	0.	0.	0.
YSNX 53	0.	0.	0.	0.	0.	96.	0.	0.	0.	0.	0.	0.	0.	96.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	96.	0.	0.	0.	0.	0.	0.	0.	96.	0.	0.
YSNX 54	0.	0.	0.	0.	0.	20.	45.	35.	0.	0.	0.	0.	0.	0.	65.	35.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	20.	45.	35.	0.	0.	0.	0.	0.	0.	65.	35.
YSNX 55	0.	0.	0.	0.	0.	20.	70.	10.	0.	0.	0.	0.	0.	0.	90.	10.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	20.	70.	10.	0.	0.	0.	0.	0.	0.	90.	10.
YSNX 56	0.	0.	0.	0.	0.	0.	0.	30.	40.	0.	30.	0.	0.	0.	30.	30.	25.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	30.	30.	40.	0.	0.	0.	55.	30.	0.	0.
YSNX 57	0.	0.	0.	0.	0.	0.	0.	20.	30.	30.	0.	0.	0.	20.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	20.	30.	30.	0.	0.	0.	20.	0.	0.
YSNX 58	0.	0.	0.	0.	0.	0.	0.	50.	50.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	50.	50.	0.	0.	0.	0.	0.	0.
YSNX 59	0.	0.	0.	0.	0.	0.	0.	25.	50.	0.	25.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	50.	0.	25.	0.	0.	0.	0.	0.
YSNX 60	0.	0.	0.	0.	0.	0.	0.	0.	100.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	100.	0.	0.	0.	0.	0.	0.
YSNX 61	0.	0.	0.	0.	0.	0.	0.	0.	0.	30.	20.	0.	0.	0.	0.	0.	50.	30.	0.	0.	0.	0.	0.	0.
	50.	30.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	30.	20.	0.	0.	0.	0.	0.
YSNX 62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	40.	0.	0.	0.	20.	20.	20.	0.	0.	0.	0.	0.	0.	0.
	20.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	40.	0.	0.	0.	20.	20.
YSNX 63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	15.	15.	5.	5.	3.	2.	5.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

See next page for notes.

NOTES:

This table was prepared from a computer printout of the default activity pattern data. For simplicity in computer programming, all data sets were designated as "YSNX" data. YSNX codes 1 through 16 represent short-term parking movements. YSNX codes 26 through 45 represent intermediate-term parking movements. YSNX codes 51 through 63 represent long-term parking movements.

All values are presented as a percent of the spaces assigned to the particular parking duration category.

Movement percentages for entering vehicles are listed above the movement percentages for exiting vehicles.

Residential Fuel Combustion Emissions

Carbon monoxide emission rates for natural gas and fuel oil combustion are quite low. Because of this, fuel use for space heating is seldom included in carbon monoxide emission inventories. Recent increases in the use of firewood for space heating, particularly with wood-burning stoves, necessitates consideration of residential fuel combustion sources. Carbon monoxide emission rates for fireplaces are more than 82,000 times higher, and those for wood stoves are almost 600,000 times higher, than emission rates for gas heaters or furnaces (comparing fuel types on an energy content basis).

The residential fuel combustion element of the emission inventories and forecasts evaluated seven fuel combustion categories: natural gas use for space heating, fuel oil use for space heating, wood stove use as the main heating source, wood stove use as a supplemental heating source, fireplace use as the main heating source, fireplace use as a supplemental heating source, and natural gas appliance use (water heaters, stoves, etc.).

Most data on fuel usage patterns were derived from a recent energy usage survey conducted for the Bonneville Power Administration (Elrick and Lavidge 1980). This survey included data for the States of Oregon, Washington, Idaho, and Montana In applying the data from this survey, no attempt was made to identify recent shifts in fuel usage patterns or to predict future shifts. Data for 1980 conditions were applied to all four inventory and forecast years.

The emission estimates were developed for community planning areas as defined in the Boise area traffic model (aggregates of traffic zones). The emission estimates were not broken down to individual traffic zones. The number of dwelling units for each community planning area was determined from the Ada County population and employment forecast report (APA 1978).

The basic calculation procedure was rather straightforward. Average daily fuel use for the November through February period was estimated for each fuel use category. This daily fuel use was then partitioned into four 6-hour time periods. Appropriate emission factors were then applied to estimate hourly and daily emissions from each fuel use category. Major assumptions and data sources are identified in Table 22.

Table 22. Data and Assumptions Used for Estimating Carbon Monoxide Emissions From Residential Fuel Combustion Sources

Topic	Data Assumption	Data Sources
Primary Space Heating Type:		
Natural Gas	28% of Dwelling Units	Elrick and Lavidge 1980
Fuel Oil	15% of Dwelling Units	
Wood Stove	9% of Dwelling Units	
Fireplace	3% of Dwelling Units	
Electrical and Other	45% of Dwelling Units	
Secondary Space Heating Type:		
Natural Gas	2% of Dwelling Units	Elrick and Lavidge 1980
Fuel Oil	2% of Dwelling Units	
Wood Stove	17% of Dwelling Units	
Fireplace	25% of Dwelling Units	
Gas Appliance Use	16% of Dwelling Units	Elrick and Lavidge 1980
Seasonality of Space Heating Requirements	65% of Annual Heating Degree-Days During November-February	National Oceanic and Atmospheric Administration 1971
Annual Natural Gas Usage for Gas Customers	1,192.5 Therms per Dwelling Unit	Elrick and Lavidge 1980
Partitioning of Annual Natural Gas Use:		
Space Heating	70.3% of Annual Gas Use	Stanford Research Institute 1972
Gas Appliances	29.7% of Annual Gas Use	
Fuel Oil Usage	Equal to Natural Gas Space Heating Usage in Terms of BTU	Jones & Stokes Associates Assumption

Table 22. Cont'd.

Topic	Data Assumption	Data Sources
Firewood Usage for Primary Heating:		Jones & Stokes Associates Calculation From Data in Elrick and Lavidge 1980
Annual	6+ Cords	
November-February	4.5 Cords	
Firewood Usage for Secondary Heating:		Jones & Stokes Associates Calculation From Data in Elrick and Lavidge 1980
Annual	2.0 Cords	
November-February	1.5 Cords	
Firewood Characteristics:		Jones & Stokes Associates Assumptions Based Partly on Data in Rhude 1976
Wood Volume Per Cord	100 Cubic Feet (78% Wood Volume)	
Wood Density	31 Pounds per Cubic Foot	
BTU Content of Major Fuels:		
Natural Gas	1,000 BTU per 10^6 Cubic Feet	Gatts et al. 1974
Fuel Oil	140,000 BTU per Gallon	Gatts et al. 1974
Firewood	7,800 BTU per Pound	DeAngelis et al. 1980
Carbon Monoxide Emission Rates:		
Natural Gas Combustion	20 Pounds per 10^6 Cubic Feet	EPA 1976
Fuel Oil Combustion	5 Pounds per 1,000 Gallons	EPA 1977
Wood Stoves	496 Pounds per cord	Jones & Stokes Associates Calculations Based on Data in Cooper 1980
Fireplaces	68.2 Pounds per Cord	
Primary Space Heating By Time-of-Day (all Fuels):		Jones & Stokes Associates Assumptions
Midnight-6 a.m.	10% of Daily Fuel Use	
6 a.m.-Noon	35% of Daily Fuel Use	
Noon-6 p.m.	20% of Daily Fuel Use	
6 p.m.-Midnight	35% of Daily Fuel Use	

Table 22. Cont'd.

Topic	Data Assumption	Data Sources
Secondary Space Heating by Time-of-Day (all Fuels)		Jones & Stokes Associates Assumptions
Midnight-6 a.m.	5% of Daily Fuel Use	
6 a.m.-Noon	15% of Daily Fuel Use	
Noon-6 p.m.	15% of Daily Fuel Use	
6 p.m.-Midnight	65% of Daily Fuel Use	
Gas Appliance Use by Time-of-Day		Jones & Stokes Associates Assumptions Based on Data in Elrick and Lavidge 1980
Midnight-6 a.m.	5% of Daily Fuel Use	
6 a.m.-Noon	35% of Daily Fuel Use	
Noon-6 p.m.	15% of Daily Fuel Use	
6 p.m.-Midnight	45% of Daily Fuel Use	

NOTES:

1 Therm = 100,000 BTU
BTU = British Thermal Unit
Heating degree days are based on temperature threshold of 65°F

REFERENCES CITED

Ada Planning Association. 1978. Demographic and employment distribution to the year 2000. Boise. 198 pp.

Benesh, Frank H., and Kenneth W. Wiltsee, Jr. 1979. Carbon monoxide emission inventory and analysis of nonattainment in Ada County, Idaho: final report. GCA Corporation, Bedford, MA. Prepared for U.S. Environmental Protection Agency, Idaho Operations Office. 40 pp.

COMSIS Corporation. 1978. Boise urban area transportation planning models. Prepared for Idaho Transportation Dept., Boise.

Cooper, John A. 1980. Environmental impact of residential wood combustion emissions and its implications. J. Air Pollut. Control Assoc. 30(8):855-861.

De Angelis, D. G., D. S. Ruffin, and R. B. Reznik. 1980. Preliminary characterization of emissions from wood-fired residential combustion equipment. U.S. Environmental Protection Agency, Research Triangle Park, N.C. EPA-600/7-80-040. 145 pp.

Elrick and Lavidge, Inc. 1980. The Pacific Northwest residential energy survey, vol. 1: executive summary. Bonneville Power Administration, Portland, OR. 81 pp.

Gatts, Robert R., Robert G. Massey, and John C. Robertson. 1974. Energy conservation program guide for industry and commerce. National Bureau of Standards handbook no. 115. U.S. Government Printing Office, Washington, D.C.

Nelson, Randy. January 7, 1981. Transportation networks for transportation years. Memorandum from Ada Planning Association to Bob Sculley, Jones & Stokes Associates, Inc. 3 pp.

Rhude, Maurice J. 1976. Wood design and construction. Section 11 in Frederick S. Merritt, ed., Standard handbook for civil engineers. 2nd ed. McGraw-Hill, New York.

Smith, Malcolm, and Tom Aldrich. 1977. Development of revised light-duty vehicle emission-average speed relationships. Prepared for U.S. Environmental Protection Agency. 254 pp.

Stanford Research Institute. 1972. Patterns of energy construction in the United States. Prepared for U.S. Office of Science and Technology. U.S. Government Printing Office, Washington, D.C. 156 pp. + appendices.

U.S. Environmental Protection Agency. 1974. Natural gas combustion. Section 1.4 in Compilation of air pollutant emission factors, 2nd ed., supple. 3. Prepared by Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

__________. 1977. Fuel oil combustion. Section 1.3 in Compilation of air pollutant emission factors, 2nd. ed., supple. 7. Prepared by Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

__________. 1978a. Guidelines for air quality maintenance planning and analysis, vol. 9: evaluating indirect sources. rev. ed. Prepared by Office of Air Quality Planning and Standards, Research Triangle Park, N.C. EPA-450/4-78-001. 165 pp. + appendices.

__________. 1978b. User's guide to MOBILE 1: Mobile source emissions model. Prepared by Office of Air, Noise, and Radiation, Washington, D.C. EPA-400/9-78-007. 133 pp.

U.S. National Oceanic and Atmospheric Administration. 1971. Climate of Idaho. Climatography of the United States No. 60-10. Prepared by Environmental Data Service, Silver Spring, MD.

APPENDIX B

Fiscal Overview on Ada County

Prepared for:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

By:

Gruen Gruen + Associates
564 Howard Street
San Francisco, CA 94105

July 1980

TABLE OF CONTENTS

Page

APPENDIX B - INTRODUCTION B-1

Fiscal Overview B-1

I. Local Public Services and Finance in Ada County B-2

- A. Service Provision B-2
- B. Organization of Local Government Finance B-2

II. Fiscal Prospects: The Short-Run Picture B-6

- A. Declining Revenues B-6
- B. Uncertain Direction of Future Implementation of Initiative No. 1 B-7
- C. The Current Fiscal Response B-8
- D. Hidden Costs B-9
- E. Need for Action B-9

III. Fiscal Prospects - The Long-Run Picture B-10

- A. Stabilizing Revenues B-10
- B. Administrative Remedies B-11
- C. More Comprehensive Financial Planning B-12
- D. Going Private B-12
- E. Land Use Planning Responses B-13

IV. Area Summary B-14

- A. City of Boise B-14
- B. City of Eagle B-15
- C. County of Ada B-15
- D. The Southwest Area B-16
- E. Conclusion B-17

LIST OF TABLES

Table		Page
B-1	Property Taxes As Proportion of Local Budget In Selected Ada County Jurisdiction	B-3
B-2	Revenue Sources In Boise And Eagle	B-4

Appendix B

INTRODUCTION

Fiscal Overview

Between 1975 and 2000, Ada County is expected to more than double its population, growing from 139,400 to 293,000 residents. This growth, which a regional wastewater facility would in part accommodate, will require significant expenditures of both public and private funds in order to provide the services needed by present and new residents, among which schools, roads, public safety, water supply, storm drainage and wastewater services may be mentioned. One of the many underlying issues in considering regional growth relates to the ability of local public service agencies to pay for that growth.

This issue of fiscal capability has been addressed by Gruen Gruen + Associates through interviews with staff and elected officials of local general purpose governments supplemented by a review of relevant documents. Of particular concern is the effect of 1978 state referendum limiting property taxes to one percent of market value. At the present time, the fact that the Idaho State Legislature has not yet enacted a detailed program to implement the initiative both beclouds the long-run future and compounds the short-run fiscal difficulties of local governments in Ada County. However, a description of current fiscal conditions and likely future adjustments provides a useful basis for a qualitative assessment of the ability of local service entities to continue to finance their future activities and to provide local residents with an acceptable level of public services.

This fiscal review begins with a discussion of local service delivery and finance in Ada County. The second and third sections discuss short- and long-run fiscal prospects for general purpose governments in Ada County. A concluding section provides an overview and commentary for each of the four major areas addressed by the wastewater facilities plan: Ada County, the City of Boise, the City of Eagle and the southwest area.

I. Local Public Services and Finance in Ada County

A. Service Provision

There is a wide variation in the specific pattern of responsibility for service provision in the greater Boise area. First, certain services are provided by the public in some areas and by private entities or individuals themselves in other areas. For example, while urban populations of Boise are provided sewer service by the public, in less densely settled portions of Ada County on-site wastewater systems are frequently installed and maintained by individual property owners.

Second, certain services are provided by local general purpose government in some areas (particularly in Boise) and by special purpose districts in others. In the City of Eagle, virtually everything except general government is provided by independent agencies: sewer, water, schools, fire. Throughout the county, public education is provided by school districts rather than by general purpose government.

These variations suggest the difficulty of generalizing about either service provision or cost/revenue issues. Depending on where a residence or business is located, it may receive a different package of public services from a different set of service providers, and these differences result in further differences in the quality/quantity of service provided and its cost. Altogether, there are 50 different public agencies in Ada County with service responsibilities and taxing authority.

Finally, it is often the case that the chief city in a region provides certain services not provided by other public agencies in the region, and this is true in Ada County. Boise provides an Art Gallery, the Boise Zoo, certain activities of the Boise Recreation Department, and the Boise bus system which are supported by Boise taxes but used by many people living outside Boise. A 1977 study found that the proportion of users of the first three of these services who live in Ada County outside Boise is about 27 percent, the same percentage as the total non-Boise population in the county. These out-of-city users do not pay taxes for what they evidently consider "regional" services (Groebner and Merz, December 1977).

B. Organization of Local Government Finance

Certain of the features of local government finance in Idaho are common to the various entities empowered to provide services and to tax, and these similarities arise from state legislation regulating the operations of local governments. Some of the most important aspects of the finance system are described below.

1. Balanced budgets. The State of Idaho requires that the budget for any given year must be in balance. Neither can a deficit be incurred nor can a surplus be accumulated. As a practical matter, this means that local agencies typically understate their revenue anticipation so as to ensure that they will not find themselves with a revenue shortfall at the close of the fiscal year.

An exception to the rule is Boise, which operates on a tax anticipation basis rather than a cash basis, a practice predating the state's 1977 balanced budget requirement.

2. Revenue sources. Property taxes have long been the mainstay of local government finance in Idaho. Table B-1 shows the extent to which local governments in Ada County have depended on property taxes in the past. This dependence has been declining throughout the 1970's, and the one-percent initiative seems likely further to reduce local agencies' reliance on the property tax.

Table B-1. PROPERTY TAXES AS PROPORTION OF LOCAL BUDGET IN SELECTED ADA COUNTY JURISDICTIONS

	Ada County	Ada County Highway District	City of Boise	Boise School District
1971	42.1%	39.3%*	36.2%	51.4%
1976	33.4%	37.5%	19.01%	48.6%
1979-80	43.7%	31.6%	15.09%	43.6%

*1972.

Source: Boise City, 1979-80. Boise City Budget.

Other taxes may be imposed at local option if authorized by state legislative action. Examples of such taxes now in effect are taxes on liquor-by-the-drink in McCall and Sun Valley (both major visitor areas). The sales tax, which is an important local tax in some other states, is a trivial element in the local tax structure in Idaho, although a local sales tax could be tacked onto the state's three-percent rate as a local option (again, state approval would be a prerequisite)

Other current revenue sources include federal and state grants and revenue sharing; fees, fines, reimbursements for services, licenses and permits; interest; rents; and miscellaneous other sources. Table B-2 sets forth the distribution of revenues in the Cities of Boise and Eagle in their 1979-80 budgets.

Table B-2. REVENUE SOURCES IN BOISE AND EAGLE

	City of Boise		City of Eagle	
Source	Annual Revenue (Thousands)	Proportion from That Source	2nd Quarter Revenue (Thousands)	Proportion from That Source
General/ Property Taxes	10,100.0	15.1%	18.3	55.0%
State Shared Sales Tax and Liquor Tax	1,300.0	1.9%	3.6	10.8%
Federal and State Grants	27,000.0	40.5%	0.2	0.6%
Revenue Sharing	1,700.0	2.5%	3.2	9.6%
Fees, Fines and Reimbursements for Services	12,700.0	19.0%	6.6	19.8%
Licenses and Permits	800.0	1.2%	0.5	1.5%
Interest Income	400.0	0.6%	0.9	2.7%
Rents	2,000.0	3.0%	-	-
All Other	10,800.0	16.2%	-	-
TOTAL	66,700.0	100.0%	33.3	100.0%

Source: Boise City, 1979-80. Boise City Budget, p. xvii. Eagle City, 1980. Statement of Revenue for the Quarter Ended March 31, 1980. Note that Eagle's revenue statement is for the second quarter of the fiscal year while Boise's is an estimate for the entire fiscal year. Comparable data for the county are not available.

3. Administrative structure for property tax collection. Each local taxing entity sets its own tax rate. Because the jurisdictional boundaries of these entities differ, neighboring properties can have different composite tax rates if their properties lie in different taxing districts. Each possible combination of taxing districts is called a tax code area and in Ada County there are over 200 different tax code areas, which is to say areas within which the combination of service-providing

entities (and therefore the composite tax rate) is different from all other areas of the county.

While the one-percent initiative and related state legislation limited the basic property tax take to one percent of market value, it did not revise the administrative structure, and that has made the impact of the initiative more severe. Since state law provides that each taxing entity must have a uniform rate of property taxation throughout its jurisdiction, each tax code area within that jurisdiction shows the same tax rate for that particular service. But since in no tax code area may the composite rate exceed the one percent of market value level, the tax code area in which the maximum tax burden is imposed is the highest tax code area in the county, and the rates in all tax code areas with service entities overlapping the one percent area must reduce the various service entities' tax rates in order to maintain the same rates throughout each service jurisdiction.

Thus, the one percent upper limit is not achievable throughout the county: most tax code areas must have lower rates in order to observe the requirement of rate consistency within jurisdictions, and as a result the reduction in property tax revenues effected by the one-percent initiative has been considerable. A recent study (Business Economics, Inc., 1979) estimates Boise City's reduction in property tax revenues as 55.36 percent, and every taxing entity whose jurisdiction overlaps the City of Boise (for example, Ada County and the Boise School District) has had to absorb the same reduction.

4. Market values and property taxes. Property taxes generally are calculated as the rate (determined by the taxing entity) times the value of the property, which in most parts of the United States is the assessed valuation as determined by the county assessor's office.

It is typically the case that state law mandates or guides the manner in which local officials value property. Idaho law requires that by 1982 assessed valuations must be a uniform 20 percent of fair market value. In the past, there has been considerable variation in local valuation practice, and a more typical ratio of assessed valuation to market value was probably 10 percent. While certain local governments (such as Boise) moved rapidly in response to the legislation to bring their valuations up to the 20 percent level, others moved more slowly, and when Initiative Petition No. 1 passed, property in those jurisdictions was still undervalued. These governments have been able to revalue property to the 20 percent level since the initiative passed, and this has cushioned somewhat the immediate impact of the initiative in those jurisdictions.

Under the provisions of the one-percent initiative, property may be revalued but the revaluation is limited to an increase of two percent per year from a 1978 base. Over time, assuming recent inflation rates persist, the property tax base will represent an ever decreasing portion of total market values as a result of this limitation. Only new improvements and properties that change hands are excluded from this limitation.

5. Bonding. It is common practice throughout the nation for the capital facilities requirements of public services to be financed through bonds. Such government bonds may be either general obligation bonds (repaid from the jurisdictions' general revenues, such as property taxes) or revenue bonds (repaid through charges imposed for the specific service provided by the facility financed via bonds).

These kinds of public finance instruments have not been used as extensively in Idaho as they have in more urban states and as a result none of the local jurisdictions - Boise, Eagle or Ada County - has reached the limit of its bonding capacity (ten percent of assessed valuation). This finance tool must be mentioned, however, because it represents one of several possible ways of financing public improvements independently of restrictions on property taxes (bonded indebtedness is specifically excluded from the one-percent property tax limitation). On the other hand, financing via bonds is not particularly popular in Idaho, where there is a strong tradition of pay-as-you-go financing. School bonds have failed to receive the required two-thirds approval in the past, and every bond measure - such as the $7,000,000 airport bond measure approved by Boise voters in November 1979 - must be fully explained to and understood by the voters in order to obtain approval.

II. Fiscal Prospects: The Short Run Picture

In the short run, all three local general purpose governments - Boise, Eagle and Ada County - are experiencing similar conditions: a sharp decline in revenue relative to three years ago, and consequently pressure to accommodate this change by altering the revenue structure and/or the volume of service delivered.

A. Declining Revenues

Initiative 1, as the Idaho legislature has implemented it on an interim basis, has frozen local budgets for a three-year period at their 1978 levels. In anticipation of the passage of the initiative, some local governments had already begun to trim budgets prior to June 1978, and it is those governments (Boise is one) that have been hit hardest by the across-the-board budget freeze.

With budgets frozen during an inflationary period, the actual fiscal impact is more severe than simply a frozen budget may suggest. The costs of providing government services, like the costs of other goods and services in the economy, continue to rise with inflation. Just as households have to spend more to maintain their historic standard of living, governments have to spend more to maintain their historic levels of service delivery. That simply cannot be done on a frozen budget. The result, as described by an Eagle councilman, is that by mid-1980, his city's ability to spend was about 50 percent of what it had been three years before.

Property taxes are not the only revenues that have declined. With the rising mortgage interest rates of the last two years, the downturn in housing construction and the current recession, development-related fees have also declined, which has hit Ada County particularly hard since much of the revenue supporting the Growth Management Department derives from fees. Fee levels have been increased, but total collections still appear to be falling short of the level normally needed to support past levels of planning and land development regulation activities.

B. Uncertain Direction of Future Implementation of Initiative No. 1

The passage of the initiative did not specify the means of implementation, and the State of Idaho (lacking the kind of surplus that California had when the similar Proposition 13 was passed in that state) has taken only interim measures to date to remedy some of the problems posed by the property tax limitation. An important step has been the earmarking of certain revenues from the three percent state sales tax to relieve the fiscal plight of the school districts.

However, further measures appear in doubt. The apportionment question (how to allocate tax rates or total tax revenues among taxing districts) poses a particularly difficult problem for whoever decides to address it, whether at the state level or at the county level. And with this question unresolved, local agencies, particularly those in the faster-growth areas, are left not only poorer but without official guidance on their future fiscal organization. On the other hand, their straitened circumstances have required immediate action.

C. The Current Fiscal Response

Cities and the county are taking a number of steps to bring their costs into line with their current revenue streams. Among these are the following:

1. Annexation policies. The City of Boise is looking much harder at annexations before proceeding with them, this caution stemming from the city's limited ability to extend services to new areas. While Eagle is still considering annexations (the Middlebrook annexation in particular), the development process is to be structured in phases to permit the city flexibility to adjust later phases in the event circumstances (such as service capacities) alter in the meantime. Ada County, for its part, is giving increasing weight to the desirability of ensuring that new urban scale development take place within municipal contexts rather than in unincorporated areas - a step which should reduce the county's service responsibilities to such areas over time.

2. Cost reductions. The most common cost reduction strategies, which all three agencies are pursuing to some extent, are (1) reducing personnel costs, (2) eliminating capital facilities expenditures to those financed wholly by federal funds and (3) reducing maintenance expenditures. Boise offered several specific examples. The city's permanent staff has dropped from 1,100 to about 700. (This drop has been accomplished both by attrition and by a layoff of 258 staff members, including 22 firemen.) Certain services are being spread more thinly or discontinued altogether. Some examples: grass cutting in public green spaces is being reduced, the smaller contribution to the Humane Society is increasing the dog population of the city (and concomitantly reduced animal enforcement is reducing dog license revenues), the diets of the zoo animals are being reviewed to determine what cost savings are possible, and the weed control ordinance has been repealed. Not all of these reduced services meet public approval, but the city feels it must make these and comparable changes to keep costs and revenues balanced. The representatives of each of the three governments generally echo the view that the voters seem to want cuts only in those services which do not affect them - but as every service benefits somebody, no cuts can be completely painless.

The maintenance reduction is particularly worrisome to public finance personnel, who feel that this strategy simply builds up major public facility expenditure needs sooner than would be required if ongoing maintenance could be kept at its past levels.

Reproduced from
best available copy.

3. Reexamination of local government's public service role. The irony of Initiative No. 1 is that it cuts back on the resources of that level of government which had been thought to be most readily responsive to the electorate, while it does nothing to reduce the spending or the obtrusiveness of the state and federal governments. But local governments must respond to the mandate to limit their roles, and one likely target for reduction is services not mandated (or reimbursed) by federal or state requirements. Emergency medical services provides a good example in Ada County. Public transportation, too, is a service Boise provides (partly under pressure from the federal government stemming from air quality considerations) which is presently not mandated and is heavily subsidized.

D. Hidden Costs

One of the concerns local governments express is that of being able to cope with sudden expenses, or with long-term costs of public improvements not now being undertaken. The recent problems faced by many Pacific Northwest communities in cleaning up in the aftermath of Mount St. Helens ash fallout provides an excellent example of public costs that cannot readily be foreseen but must be dealt with on a crisis basis. An example of the second kind of problem is surface water drainage, a need not being addressed on a coordinated basis in Ada County at present. Costs of coping with this problem, which is particularly acute in the area to the southwest of the City of Boise, may well exceed the $20,000,000 level. Such costs of "new" services will be difficult for existing governments to absorb under current strapped fiscal conditions.

E. Need for Action

Public officials of all three jurisdictions - Boise, Eagle and Ada County - agree on the importance of responding to the property tax limitation initiative in a manner that will permit restoration of adequate levels of public service. Although the approaches which at present seem most appealing differ among jurisdictions, there is agreement on the desirability of coping responsibly with future needs so as to allow a resumption of regional growth along the lines desired in each community.

Local governments are particularly concerned about some of the adverse impacts that may result from Initiative No. 1. Among these are the loss to public agencies of good staff people who may resign if they feel long term opportunities are better elsewhere. Another is the concern that a decline in public service levels could prove a disincentive to firms to locate in the region. In particular, high technology firms that consider a number of regions when locating a new plant are known to be particularly sensitive to the quality of the educational system locally, as their highly-trained professional and technical people insist upon this feature in deciding whether to accept assignment to new locations. So if the Boise area is to continue to move in the direction of diversifying and strengthening its economic base by adding clean industry of this kind, there is a limit to the extent of cost-cutting in public services that can be accommodated consistent with economic development objectives.

These kinds of concerns have motivated local government to look beyond the current problems of coping with the Initiative One aftermath to future questions of efficiency and productivity in service delivery and long run solutions to revenue problems.

III. Fiscal Prospects: The Long Run Picture

Although public service finance in the Boise region faces definite current difficulties, most observers from all three jurisdictions see some positive outcomes of Initiative One and point to a number of future actions to relieve the current crisis and put local general purpose governments on a firmer footing.

A. Stabilizing Revenues

Although, unless there is a 2/3 override of the property tax limitation, it appears that public revenues from that source will provide a decreasing proportion of local government revenues as time goes on, other sources of revenue have been identified and will eventually be tapped. Among those specifically mentioned by local agencies are general obligation bonds (exempt from the provisions of the initiative), special purpose bonds such as for industrial development and housing finance (require state enabling legislation but are common in other states), local option taxes and state payments in lieu of taxes. The latter revenue source would be of particular assistance to the City of Boise, which hosts the state government and has within its municipal boundaries a considerable amount of state property not subject to property tax though eligible for city services.

All jurisdictions are looking to imposition of user charges (authorized by state legislation) and imposition or increases in fees wherever possible. Ada County in particular has been considering growth management fees in line with a study the Ada Planning Association Board commissioned with funds from the Pacific Northwest Regional Commission. Although the methodology of that study has been criticized by some readers, there is general agreement that under current fiscal conditions some residential development probably does not "pay its own way"; the main arguments lie in (1) whether a growth management fee - a fee to cover the capital costs of future public services - is the proper response to this situation, and (2) how to allocate capital costs among various types of land use. Using other states' experience as an indicator, certain fees (such as for school site dedication and park dedication) have been upheld by the courts and are in widespread use, and the principle is certainly readily applicable to such other services as fire and police. Even its advocates recognize, however, that this approach covers only capital facilities, leaving open the question of the ongoing financing of operating costs. And if payment of such fees is required to precede issuance of permits, the magnitude of the charges may well be sufficient to deter some development.

B. Administrative Remedies

1. Solving the apportionment problem. A problem discussed earlier is that of imposing the maximum one percent property tax rate in all tax code areas, which is not possible currently due to discontiguity among taxing districts. This problem could be solved (as California has solved it) by imposing the one percent tax on a county-wide basis and then apportioning the revenues among taxing districts. Thus far, the legislature has not proposed this approach, and county commissioners (who are familiar with county budgets but are certainly much less familiar with the problems of the special districts) have not been willing to take aggressive action in this direction. Although the situation appears currently to be at an impasse, most observers feel that a solution to the problem will eventually be hammered out - if only because, in the interim, tax revenues are going to fall far short of the permitted one percent level in most areas of most counties. So there is a powerful impetus for solving this problem.

2. District consolidation. The apportionment problem has called public attention to the number of special purpose taxing districts in Ada County, and the general feeling is that the number (around 50) is excessive. Economies of operation may well be possible if certain districts are consolidated. Such consolidation can take place either on a functional basis (i.e., several fire districts merging into one) or on a geographic basis (fire, open space, wastewater service to a given

area provided by a single district - just as city governments generally operate). Both of these kinds of consolidation are being widely studied in California for the same reasons (economy and increased efficiency) they are being proposed in Idaho. The chief impediment seems to be that the special districts, with elected boards, do offer valuable opportunities to area residents for public involvement which would be reduced if the number of such districts were cut back. But the benefits of the approach are such that movement in this direction is a realistic expectation.

In the meantime, an interim measure could be the discouragement of new district formation. This appears to be the point of view of Ada County at present. The Middlebrook controversy has drawn attention to the potential problems that may arise when a city is empowered to approve an annexation and subsequent development project the principal services to which are the responsibility of other entities.

C. More Comprehensive Financial Planning

The current fiscal crisis has drawn attention to the need for more thorough-going and long run analysis of public finance requirements, which has spurred Boise in particular to begin to look at long term financial planning as an important aspect of municipal finance. This kind of planning is seen as integrated with long term development planning in a coordinated package to make public actions more efficient and consistent. Boise has also been working with a group of private-sector financial experts to improve the operation of financial planning and reporting systems, and is establishing data processing techniques to improve the capability, speed and accuracy of financial reporting systems.

D. Going Private

As mentioned earlier, there are a number of utilities or services that can be (and frequently are) performed by private entities rather than by public agencies. These include water (which in rural Ada County is generally provided by on-site wells or private services) and solid waste disposal (where householders may be individually responsible for hauling their own refuse to a dump site or for contracting with a private firm to provide this service - the City of Boise recently made mandatory household trash collection by a private service).

If the costs of providing a public service system appeared prohibitive, it might be possible in some cases simply to put the responsibility for providing that service on the individual householder. There are a number of kinds of arrangements for accomplishing this approach. Often, homeowners' associations in new subdivisions can take responsibility for such functions as landscape maintenance and weed control, pest control (functioning as mosquito abatement districts), surface water drainage, street and street lighting maintenance, and so forth. This approach relieves the public sector of financial responsibilities, and gives the appearance of making new development less costly to the public.

However, the approach doesn't make development less expensive for the new home buyer, who is paying the homeowners' association for the same services he might otherwise have been paying some public entity for, and the resident may actually end up paying more to the extent that public agencies can finance long term improvements in a less costly manner (i.e., through bonds) than private developers can. Furthermore, there has been concern expressed in other states where this approach is more widespread that these "private" responsibilities would devolve upon the public in any case should a homeowners' association go into default.

Less structured private systems, such as on-site wells and on-site septic systems, are often possible where densities are low and these approaches, too, initially look less costly from the point of view of the public treasury. But cost savings of this kind may well be offset by cost increases in other functions: more miles of roads are needed to serve dispersed development, more travel by school buses to bring children to schools, and so forth. Thus, private service provision must be thoroughly analyzed before it can be concluded, on balance, to be cheaper than the public alternative.

E. Land Use Planning Responses

1. Tying new development to existing infrastructure. The high cost of new service extensions has called attention to the advantages of utilizing existing infrastructure to accommodate new development. Such an approach reduces the commitment of capital required to serve new growth while it offers the advantage of reducing average costs of those already served by an existing system that is operating at less than capacity.

2. Contiguous development. A second way in which fiscal constraints can alter land use planning is by pointing up the advantages of contiguous development. If new development abuts existing development, costs of service extension are generally less than they would be if the newly-developing area were separated from the urban boundary by vacant or undeveloped land.

3. Cautious approach to annexation. Recognizing the lower level of financial resources available, cities may well resist annexation proposals that in the past would have been almost routinely approved. The property tax limitation initiative, in Idaho as in California, has tended to change the outlook toward annexation of both annexors and annexees. Before the initiatives, unincorporated areas often resisted annexation because their tax rates would rise; now, with tax rates more or less equalized between incorporated and unincorporated areas, this source of resistance has been greatly reduced or altogether eliminated. On the other hand, cities which in pre-initiative days considered annexations desirable because of additions to the property tax base have found that benefit much reduced, and are often legitimately concerned that the increase in property tax revenues resulting from annexation will not compensate for additions to service costs. It is for these reasons that Boise is currently discouraging annexation proposals.

4. Development phasing. The fiscal constraints local governments are now experiencing also make them more cautious about giving approvals to long-term development projects, because the service and fiscal conditions that apply when such projects begin may no longer obtain by the time of their completion. Furthermore, there are clear advantages in maintaining ongoing approval authority of large projects in the event of delays in completion, changes in ownership or management, or other conditions that might result in an alteration in the developer's intentions or objectives.

An example of the kind of project expected to be subject to approval by phases is Middlebrook. Phased approvals have been used by the City of Eagle on earlier projects, and this approach can be expected to be used more extensively by Idaho jurisdictions generally as long as the current fiscal crisis lasts.

IV. Area Summary

A. City of Boise

Boise has felt the impact of Initiative One more severely than other jurisdictions because it operates on an accrual basis and because its property had already been revalued up to near the state-mandated limit at the time the initiative passed. That the reduction in revenues has caused severe short term problems is unquestioned. However, the long term outlook is not bleak. Certain additional sources of revenues seem likely to be tapped in the future and Boise will likely continue to receive more state and federal funds, as a proportion of its budget, than do the other general purpose governments reviewed.

The fiscal crunch has underlined the practicality of some of Boise's planning policies, particularly the preference for infill development in the southeast and (to a lesser extent) the northwest. This growth corridor is the most easily serviced by municipal agencies and in many cases the infrastructure to support new development in these areas is already in place. Growth elsewhere - and particularly to the west and southwest - will be more closely scrutinized in the future, with fewer annexations, preference given to contiguous development, and a close tie-in between long term physical development planning and capital improvement planning to assure efficiency and minimum public cost.

B. City of Eagle

Eagle is still a comparatively small town, with a 1980 population probably in the range of 3,000 (a substantial increase over the population at 1971 incorporation of less than 400). The area of impact of the town, which is the city's planning area as delineated in the Ada County Comprehensive Plan, is expected to see steady growth over the next decades bringing the future population of the community to over 10,000 (exclusive of the Middlebrook development) as indicated in APA Board-adopted subarea population projections. Local projections range from 15,000 (Eagle's sewer consultant) to 20,000 and upward, and generally incorporate the Middlebrook development proposal.

The growth of the community is not expected to abate much as a result of current fiscal problems because the current scale of operation of the City of Eagle is quite modest and no immediate change in this characteristic is expected. One of the city's sources of appeal for new residents is reportedly its small town character and the direct accessibility of its government. While this can be expected eventually to change as the local population increases, the present structure of urban service provision - most services are provided by special districts charging user fees - insulates the city somewhat from the more severe effect of Initiative One noted elsewhere. The concern about Eagle's growth often expressed in the region relates more to regional planning questions than directly to fiscal capacity, although the special districts providing services to parts of Eagle City may encounter their own fiscal problems in extending services, and that has not been explored in the course of this qualitative review.

C. County of Ada

Ada County revenues have fallen short of earlier expectations because of Initiative One and lower construction activity (which has reduced fee revenues). The county has responded by trimming staff and services where possible. If the current crisis is prolonged, a reduction in non-mandated services is a reasonable expectation.

Looking beyond the immediate future, it appears that the county, like the City of Boise, will be affected by fiscal constraints in terms of its future development policies. This has already been happening to some extent, but the revenue reduction has given this direction greater impetus. There will be a reluctance to permit discontiguous development, a closer evaluation of the public costs of new development, and more assiduous observation of a policy to encourage new development to annex to existing municipalities and to obtain city - rather than special district - services. In general terms, the philosophy of the county will increasingly be to support municipal growth while unincorporated lands would be retained in rural uses. The implications of this approach in terms of the spatial distribution of growth are plain. Whether such a policy would also serve to inhibit growth is less clear.

D. The Southwest Area

The area lying to the south and west of Boise has been seen by many as a desirable growth area, and much development has taken place there in the last 10 years. Of the approximately 16 square miles in this area, about half is already subdivided, and the current population is about 14,000.

The fiscal crisis has been one factor prompting the recent reassessment of the magnitude of future growth in this area. The cost of providing urban services to the dispersed development pattern that currently exists in the area has proven to be higher than was hoped, creating resistance to construction of public wastewater facilities. And the prospect of dealing with the costs of other kinds of service needs - such as surface water drainage - may make people more cautious in the future about settling in that area. Finally, accessibility to downtown Boise - still the main employment and service center in the region - is inferior from the Southwest Area as compared to the urban corridor along the Boise River, leading some to suggest that rising energy costs will also serve to limit the growth of this area.

In addition to economic factors, there also are lifestyle preference factors involved in attitudes about urban services and growth in the Southwest Area. Many of the properties are small acreages on which owners keep animals and cultivate a more rural life style than would be possible, say, in the southeastern part of the City of Boise. These residents may object to establishment of capital intensive public services (such as a regional wastewater system) not only because of the high cost but also because they feel it is inimical to the kind of residential environment they want to retain. The view of the Ada Planning Association's Board of Directors on this matter seems to be that local residents should not be forced to pay for a system they don't want, but that planning and capital facilities decisions should not foreclose the possibility of future densification to a more urban development pattern.

Because this area is in the unincorporated county and lies within a number of special service districts, it would be difficult to characterize its fiscal prospects, but it does seem clear that the combination of lower property tax revenues and an increasing awareness of the cost of urban services may result in less growth than had been anticipated, at least over the next decade.

E. Conclusions

Although this investigation has been qualitative and no forecast of long-term public costs or revenues has been undertaken, it seems clear from the review completed that current fiscal problems are causing a reassessment of growth and planning policies in many of Ada County's jurisdictions.

While local officials believe the resources will be available to accommodate future growth, that growth is probably more likely to be concentrated in or adjacent to existing urban communities than might have been expected a few years ago, with this pattern of concentration helping to assure efficiency in urban service delivery and minimum average cost. The current recession in the economy, which has been evidenced in part by the downturn in new construction, has given local communities some breathing time to adjust their planning, development and fiscal policies in response to the new fiscal constraints they face.

An unanswered question is whether the mechanisms for guiding growth are strong and consistent enough to achieve the stated policies of Ada County and the City of Boise. If not, the southwest area may continue to experience more extensive large-lot rural development, relying on individual or private services, than local public agencies want. Elsewhere, development of outlying areas is limited under county zoning to essentially agricultural use (1 unit per 80 acres in agricultural use areas and 1 unit per 160 acres in rangeland areas) except that smaller parcels are allowed where there is no water available for irrigation (1 unit per 40 acres) or in approved subdivisions. How many undeveloped parcels exist in the latter is not known, but no new subdivisions in the rural areas have been authorized since 1977. Given this zoning pattern it does not presently appear likely that more restrictive development policies within and at the edges of urban areas would cause much rural spillover development outside the southwest area.

However, a more substantial issue is the resilience of the regional economy itself if housing prices continue to rise in response to scarcity, and housing price, type and locational availability pose disincentives to people considering moving into the region. If events take that direction, there will be more pressure on local public agencies to facilitate development through both fiscal and planning policies.

BIBLIOGRAPHY

Persons Consulted

Ayers, W. Floyd. Director of Finance and Administrative Management, City of Boise. June 9, and June 26, 1980.

Bermeosolo, Gary. Chairman, Ada County Board of County Commissioners. June 10, 1980.

Gerber, Sheldon. Planner, Ada Planning Association. June 9 and June 10, 1980.

Krasen, Orval. Councilman, City of Eagle. June 9, 1980.

Ralston, Paul L. Executive Director, Greater Boise Chamber of Commerce. June 10, 1980.

Reference Documents

Ada County. Ada County Budget. 1979-80.

Ada County. Annual Financial Statement for the Fiscal Year Ending September 30, 1979. December 1979.

Boise Chamber of Commerce. "Growth Management Labeled as Fee-bull" in Boise Business Today, Vol. 33, No. 6. July 1980.

Boise Chamber of Commerce, Blue Ribbon Committee on 1%. Memorandum on the 1% Initiative. Undated.

Boise Chamber of Commerce, Task Force on Growth Management Fees. Report. May 1980.

Business Economics, Inc. An Analysis of Growth Management Fees in Ada County, Idaho (summary report and complete text). Commissioned by Ada Planning Association Board and Office of the Governor, Division of Budget, Policy Planning and Coordination, State of Idaho. December 1976.

Eagle City. Statements of Revenues. January 1, 1977 through March 31, 1980.

Groebner, Dr. David F. and Dr. C. M. Merz. Non-resident Use of Boise City Services. December 1977.

Merz, Dr. C. M. and Dr. David F. Groebner. Study of Alternatives to the Property Tax for the City of Boise. December 1976.

APPENDIX C

ISSUE PAPER

Population Projections for Ada County EIS Analysis

Prepared By:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

With the Assistance Of:

Gruen Gruen + Associates
564 Howard Street
San Francisco, CA 94105

February 1980

TABLE OF CONTENTS

Page

Section 1 - INTRODUCTION C-1

Approach and Contents of Issue Paper C-1
Intent of EIS Analysis of Population Alternatives C-2
EPA Policy on Population Projections for Facilities Planning C-2
Historical Context C-3

Section 2 - DESCRIPTION AND ASSESSMENT OF DED PROJECTIONS C-5

Methods and Results C-5
County Total C-5
Disaggregations to Planning Areas C-6
Assessment of DED Projections C-11
Assessment of Methods C-11
Comparison with Recent Trends C-14

Section 3 - POTENTIAL ALTERNATIVE POPULATION PROJECTIONS FOR EIS ANALYSIS C-17

Boise Planning Area C-17
Southwest Planning Area C-17
Eagle Planning Area C-21
Countywide Alternatives C-21

Section 4 - ISSUES C-23

Do the Middlebrook and Southwest Area Population Increases Represent New Growth? C-23
How Will Grant Eligibility Be Determined? C-24
Are There Other Proposed Major Land Developments Which Could Increase Population Projections? C-24

APPENDIX A C-25

LIST OF TABLES

Table		Page
2-1	Summary of DWR/BSU Series 2 Population and Employment Projections	C-7
2-2	Summary of DED Planning Area Population Projections	C-8
2-3	Year 2000 Ada County Employment	C-9
2-4	Comparison of Projected 1975-1980 Population Growth with 1978-1979 Subdivision Plat Data	C-15
3-1	List of Potential Population Alternatives for EIS Analysis	C-18
3-2	Boise Planning Area Population Projections	C-20

LIST OF FIGURES

Figure		Page
2-1	Boise Metropolitan Area	C-10
2-2	Southwest Area	C-12
2-3	Eagle Planning Area and Community Plan	C-13
3-1	Boise Metropolitan Service Area and Planning Areas	C-19

Section 1

INTRODUCTION

Approach and Contents of Issue Paper

As part of the Environmental Impact Statement (EIS) being prepared by Jones & Stokes Associates, Inc., for three Ada County wastewater projects, the secondary impacts of the population growth accommodated by these projects will be analyzed. Task D-2 of the EIS scope of work requires the preparation of population projection alternatives for EIS analysis; these alternatives are intended to reflect population alternatives being proposed in the three wastewater management plans.

This issue paper has been prepared to establish the context for selection of population alternatives for EIS analysis. The paper consists of four sections and one appendix. The remainder of this INTRODUCTION (Section 1) describes the intent of the EIS analysis of population alternatives; describes the U. S. Environmental Protection Agency's (EPA) policy on population projections for facilities planning; and describes the historical context of population projections being proposed for Ada County wastewater planning. Section 2 consists of a description and assessment of the Ada Planning Association (APA) 1978 baseline population and employment projections, which were intended to serve as the baseline for the EIS analysis of alternatives. Section 3 presents a broad range of population alternatives which could be analyzed in the EIS; it is expected that several, but not all, of these alternatives will be selected for EIS analysis. The last section, Section 4, outlines several issues affecting the choice of population alternatives for further analysis. The appendix to this issue paper, prepared by Gruen Gruen + Associates (economic consultants for the Ada County EIS), presents an economic evaluation of increases in population over the 1978 APA projection proposed for two planning areas, the Southwest Area and the Eagle planning area.

Intent of EIS Analysis of Population Alternatives

The analysis of population alternatives in the EIS is intended to serve two major purposes. First, population alternatives for each of the wastewater plans need comparison to assure that they are consistent with one another. If this were not done, then theoretically population projections could be determined which seem reasonable for each area, but which, when added, produce an unrealistically high projection for the county as a whole. EPA's concern in this regard is that capacity in excess of need is not funded.

Second, population alternatives for each wastewater plan, and for the county as a whole, need to be assessed in order to determine secondary impacts and mitigation measures. A major issue in the Ada County EIS is the secondary impacts of the growth accommodated by the wastewater plans and measures to mitigate significant adverse impacts. Assessment of the impacts of alternative population projections in the EIS will lead to a greater public review of plan impacts and to an informed decision-making process.

EPA Policy on Population Projections for Facilities Planning

EPA's policy for population projections to be used for facilities planning is set forth in Appendix A of the agency's cost-effectiveness analysis guidelines (40 CFR 35, Supplement E). The policy requires wastewater facilities plans to use population projections developed by states or appearing in approved 208 plans, provided that state projections do not exceed Bureau of Economic Analysis (BEA) projections by more than 5 percent and that 208 plan projections do not exceed state projections by more than 10 percent. New BEA projections are currently being developed under increased control by the federal Office of Management and Budget (OMB) and with greater participation of states and 208 planning agencies. However, new BEA projections for substate districts are not expected until at least 1981.

In Idaho, the state baseline population projection for facilities planning was developed by the Bureau of Water Quality (BWQ) and approved by EPA on January 10, 1980; this state baseline projection was developed by extrapolating

1970-1976 growth rates for the years 1980, 1990 and 2000. The state baseline indicates a year 2000 population of 268,622 for Ada County. On January 15, 1980, the BWQ requested a revision to the Ada County projection, raising it to 289,000 as a result of APA work; this request is currently under review by EPA.

Historical Context

Several events in the 1978-1980 period are of particular importance for the development of population alternatives for EIS analysis.

Adoption of 1978 Demographic and Employment Distributions, Population and Employment Projections by APA

In August 1978, the APA adopted the report "Demographic and Employment Distributions (DED) to year 2000" (DED projections). This report presents population and employment projections, in 5-year intervals, for Ada County and for smaller statistical areas. The year 2000 projection for Ada County population was 289,000.

The DED projections were adopted as the population projection baseline for all APA regional planning programs, including 208 areawide waste treatment management planning. Therefore, at the same time the EIS scope of work was prepared, the DED projections were intended to serve as the baseline for EIS analysis as well. The DED projections are described and assessed in Section 2 of this paper.

Amendment of DED Projections Adding 7,010 to Southwest Area

In August 1979, the APA Board authorized increasing the year 2000 population of the Southwest Area from 22,380 (in the DED projection) to 29,390. This action also increased the county total from 289,010 to 296,010. The change was based upon a more detailed evaluation of subdivision lots than was done for the DED projections.

Proposed Middlebrook Development

In spring 1979, a major development was proposed on 520 acres south of the City of Eagle. The Ada County Zoning Department estimates that this development would generate 2,000-7,000 jobs and 700-800 dwelling units. About half of the development would be devoted to a "technological park", which would be a significant employment generator.

Population implications of this development have not been fully assessed by local agencies. However, a working figure of 16,000 for the year 2000 population of the Eagle planning area has been advanced; this represents an increase of 5,745 people over the DED projection of 10,255. Ultimate induced population from the Middlebrook development would be considerably higher than the 5,745 estimate.

On December 4, 1979, a letter from EPA to the Eagle Water and Sewer District indicated no agency objection to planning for a population higher than 10,265, such as 16,000, but indicated that design and construction of facilities funded by state and EPA grants must conform to the 10,255 figure unless the 208 plan (DED projections) is formally amended. APA has expressed disagreement with this EPA decision.

EPA Approval of Idaho Baseline Projection

On January 10, 1980, EPA approved the Idaho baseline population projection, developed by the BWQ, which indicates a year 2000 Ada County population of 268,622.

BWQ Revision to Baseline Projection

On January 15, 1980, the BWQ requested revision of the year 2000 Ada County population projection to 289,000. This revision is based on the APA DED projections.

Section 2

DESCRIPTION AND ASSESSMENT OF DED PROJECTIONS

Because the DED projections were intended to serve as the baseline for EIS analysis, and because they continue to serve as baselines for wastewater facilities planning for areas other than the Southwest Area, this section reviews the methods and results of the DED projections. The section concludes with a brief assessment of the methods and results of the projections.

Methods and Results

County Total

Methods. The DED year 2000 population projection of 289,000 for Ada County was based on the DWR/BSU 1976 population and employment forecast (also referrred to as Idaho Population and Employment Forecasting Model [IPEF] 73). It should be noted that the 1976 DWR/BSU projections were revised in 1978, and that the "Series 2" projection for year 2000 Ada County population is 293,581. The Series 2 projections are based on an extended employment data base covering 16 years of data (1961-1976) instead of the original 6 years (1967-1972).

The DWR/BSU projections were prepared by using the IPEF model, which consists of two separate forecasts: 1) a population forecast prepared by using the cohort survival method and 2) an employment projection which is then converted to a labor demand projection. The model compares the population forecast to the labor demand projection, and adjusts the population forecast so that a balance is achieved.

Results. A summary of the Series 2 population and employment projections is presented in Table 2-1. Population is projected to more than double from 136,140 in 1975 to 293,580 in the year 2000. Total employment shows a similar increase, from 67,520 jobs in 1975 to 149,010 jobs in the year 2000.

As mentioned, the Series 2 year 2000 population projection of 293,580 is somewhat higher that the original DWR/BSU year 2000 projection of 289,000. The difference between the two amounts is 4,580 people.

Disaggregations to Planning Areas

Methods. The DED projections were disaggregated to subcounty planning areas and to smaller traffic analysis zones by APA. Only the planning area disaggregations are reviewed here. The DED report (page 5) indicates that the disaggregations to planning areas were performed using the following general methods:

> ". . . the most recent planning goals and policies for each area (metro planning areas, small cities, subsections of planning areas, etc.), were considered. Approved and expected developments, County/Metro Land Use Plan and recommendations, historical trends, service planning areas as related to capacities, economic housing type trends, and growth patterns in each of these smaller units were the basis for determining the future population and employment distribution for the County."

Results. The results of the DED planning area projections are summarized in Tables 2-2 (population) and 2-3 (employment)*. Further detail regarding the projections for the Boise Metro Area (excluding the Southwest Area), the Southwest Area, and Eagle are provided below.

Boise Metro Area (Excluding Southwest). Separate projections were prepared for southeast Boise, north river west bench, and central bench (see Figure 2-1 for a map of these areas). These projections take into account factors such as recommended densities and other policies in the Boise Metro Plan, the Garden City Plan, and the City Center Plan; available vacant land in each planning area; and development constraints such as the floodplains, power lines, canals and benches.

---

*The DED projections were based on "Series 1" DWR/BSU county totals, which are slightly lower than the Series 2 projections presented in Table 1.

Table 2-1. Summary of DWR/BSU Series 2
Population and Employment Projections

	1970	1975	1980	1985	1990	1995	2000
Total population	112,230	136,140	166,340	192,380	222,810	254,800	293,580
Total employment*	57,080	67,520	82,800	95,490	110,500	127,710	149,010
Labor force**	55,180	68,070	83,400	95,920	111,060	128,320	149,640
Total school enrollment	33,860	39,410	46,270	52,620	61,810	70,520	80,440
Nursery	300	390	500	580	650	720	830
Kindergarten	1,330	2,030	2,690	3,210	3,740	4,130	4,640
Elementary	18,730	19,690	22,990	27,720	32,830	37,090	41,640
High school	9,080	11,360	12,500	12,570	15,380	18,220	21,180
College	4,420	5,920	7,570	8,510	9,200	10,340	12,130
Household heads	35,830	43,860	54,010	63,130	73,630	84,420	97,730

* Employment base year = 1972

**Labor force base year = 1970; labor force is dependent upon unemployment rate and the average number of jobs held by each worker

SOURCE: Idaho Department of Water Resources/Boise State University, 1978. Population and Employment Forecast -- State of Idaho, Series 2.

Table 2-2. Summary of DED Planning Area Population Projections

	1975	Additional	2000	Year 2000 (% of Total)
Southeast	11,425	42,100	53,525	18.5
North River	35,650	34,300	69,950	24.2
City Center	2,940	3,715	6,655	2.3
North End	17,180	930	18,110	6.3
Northwest	5,310	19,145	24,455	8.5
Foothills	6,725	8,431	15,156	5.2
Warm Springs	3,495	2,079	5,574	1.9
West Bench*	28,700	16,415	45,115	15.6
Central Bench	36,105	7,250	43,355	15.0
Southwest	9,080	13,300	22,380	7.7
Total Metro	120,960	113,365	234,325	81.1
Meridian	6,349	18,801	25,150	8.7
Eagle	2,720	7,505	10,225	3.5
Kuna	1,308	5,517	6,825	2.4
Rural Area**	8,063	4,412	12,475	4.3
Total Nonmetro	18,440	36,235	54,675	18.9
Total Ada County	139,400	149,600	289,000	100.0

* Includes Garden City
**Includes Star

SOURCE: Ada Planning Association, 1978. Demographic and Employment Distribution to the Year 2000: Ada County, Idaho.

Table 2-3. Year 2000 Ada County Employment

	Retail Pers. Ser.	Office Finance	Ind., Const. Wholse., Transp.	Gov't.	Educ.	Social Recreation	Total
Southeast	3,469	6,548	3,319	223	2,847	359	16,765
North River*	18,426	24,382	3,666	15,512	2,069	1,615	65,670
City Center	14,841	21,290	1,480	11,159	684	1,126	50,580
North End	901	546	506	1,116	393	131	3,593
Northwest	1,516	372	965	670	547	177	4,247
Foothills	915	540	365	1,451	300	94	3,665
Warm Springs	253	1,634	350	1,116	145	87	3,585
West Bench	5,069	1,738	5,286	1,228	992	298	14,611
Central Bench	4,644	4,475	4,543	1,428	949	307	16,346
Southwest	1,700	287	14,693	2,277	487	161	19,605
Total Metro	33,308	37,430	31,507	20,668	7,344	2,740	132,997
Meridian	2,386	455	1,531	737	566	150	5,815
Eagle	581	158	510	290	222	59	1,820
Kuna	405	97	335	179	154	33	1,203
Rural Area	422	121	1,770	445	274	62	3,094
Total Nonmetro	3,794	831	4,146	1,651	1,206	304	11,932
Total Ada County	37,102	38,261	35,653	22,319	8,550	3,044	144,929

*North River = City Center + North End + Northwest + Foothills + Warm Springs.

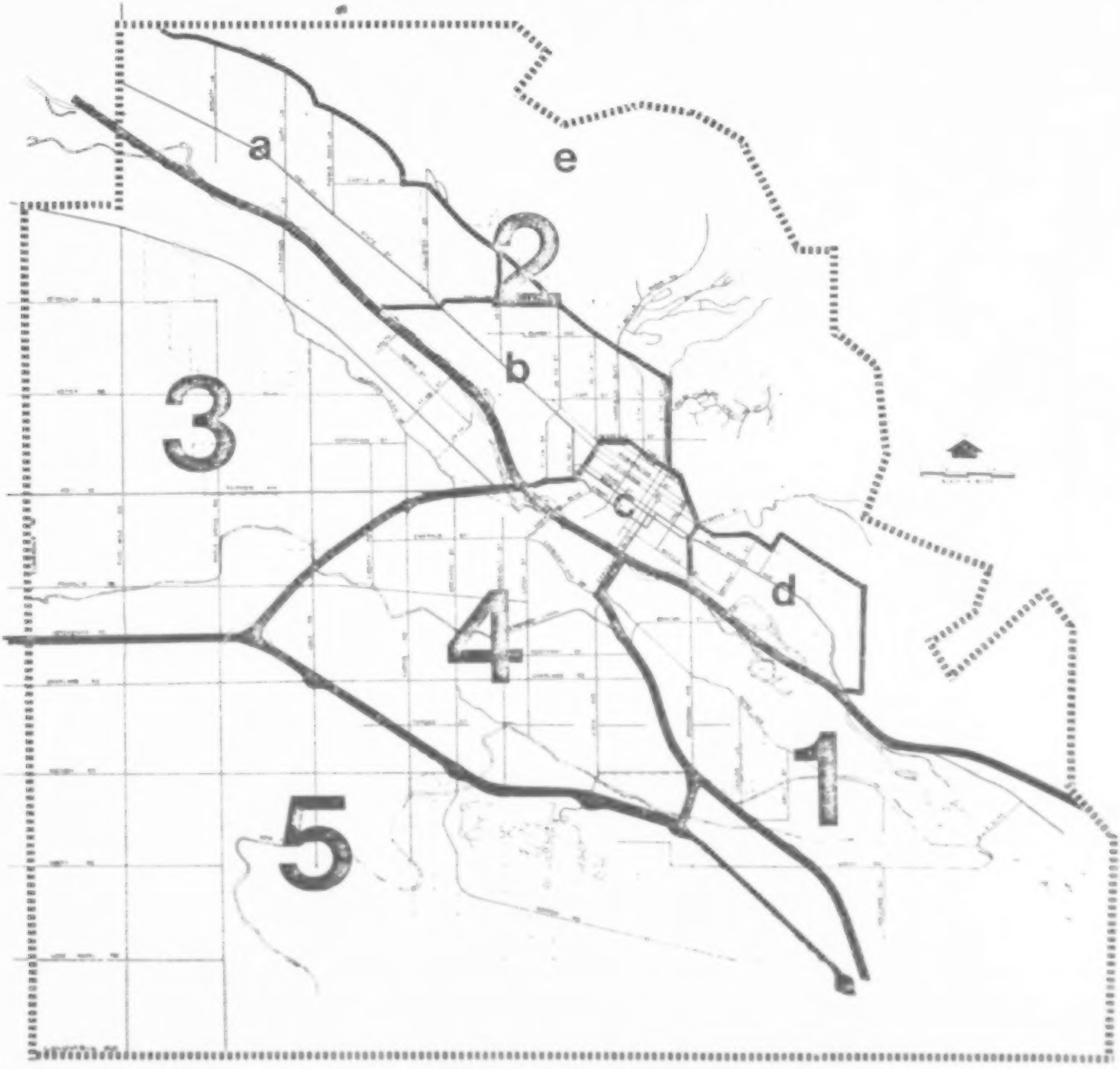
SOURCE: Ada Planning Association, 1978. Population and Employment Distribution to the Year 2000: Ada County, Idaho.

Figure 2-1

Boise Metropolitan Area

PLANNING AREAS

1. Southeast
2. North River
    - a. Northwest
    - b. North End
    - c. City Center
    - d. Warm Springs
    - e. Foothills
3. West Bench
4. Central Bench
5. Southwest



SOURCE: Ada Planning Association, 1978. Population and Employment Distribution to Year 2000: Ada County, Idaho.

Southwest Area. The Southwest Area population projection of 22,380 was based on several factors (see Figure 2-2 for map of the Southwest Area). These include a Boise Metro plan recommendation that development incompatible with the airport influence zone not be allowed and an assumption that the Southwest Area would remain low density and not reach the density of 4-5 dwelling units per acre thought to be needed to support a central water and sewer system. The assumption that the area would remain low density was in response to recommendations of the Boise Metro plan to channel growth to southeast and northwest Boise, and also in response to expected transportation constraints and high costs of a central sewer system.

Eagle. The year 2000 projection of 10,255 for the Eagle planning area was based on the 1978 Eagle comprehensive plan. This plan supports an overall policy of limited growth and maintenance of Eagle's semirural community character. Figure 2-3 shows the Eagle planning area and community plan.

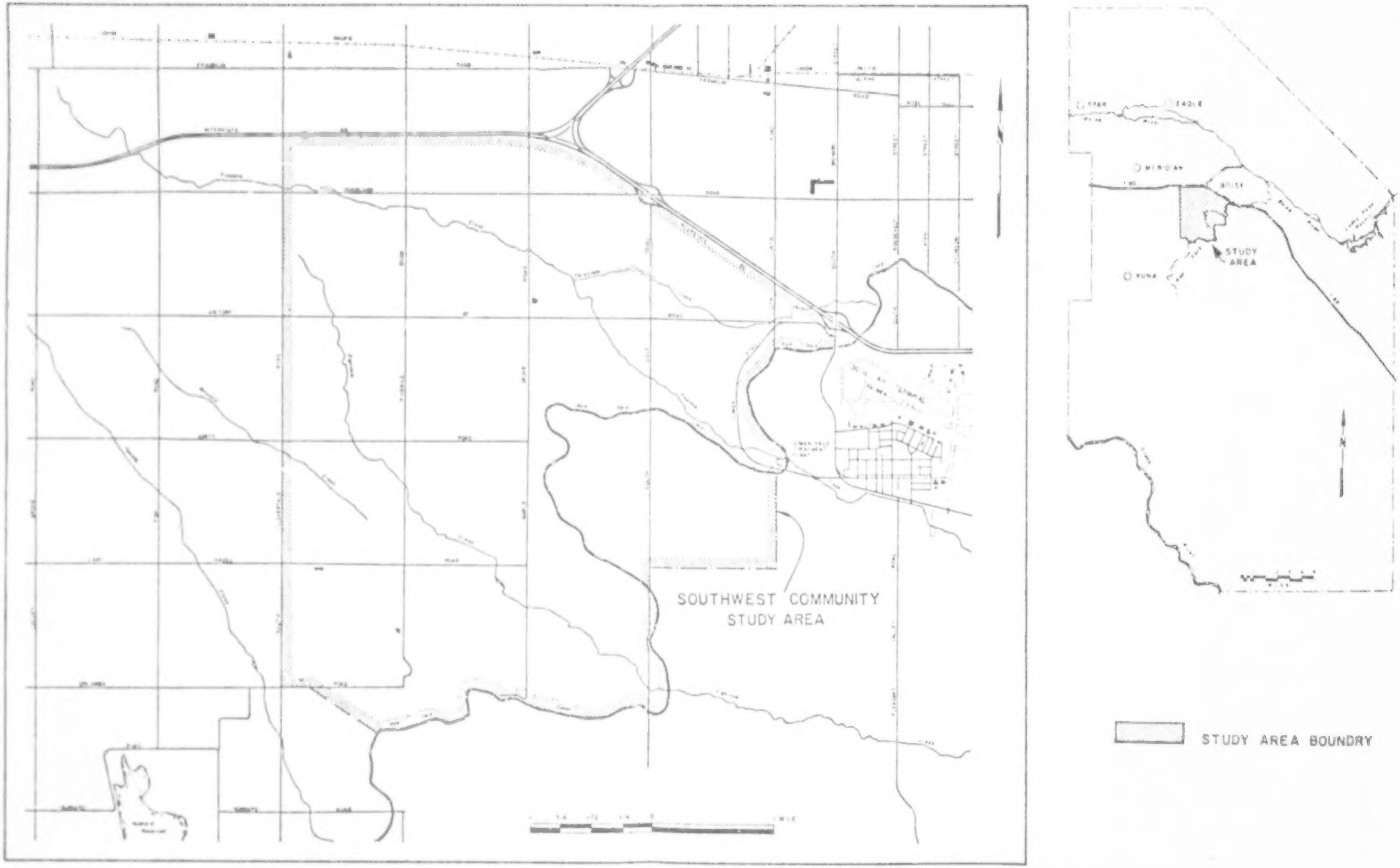
Assessment of DED Projections

Assessment of Methods

The IPEF model used to prepare the DWR/BSU projections is an excellent, flexible tool which can be used to observe the sensitivity of population to changes in demographic or economic variables. The model avoids the error of assuming that past growth rates will continue into the future when economic circumstances have changed. It should be recognized, however, that the DWR/BSU projections of county population do not recognize local land use policies or local environmental constraints to growth.

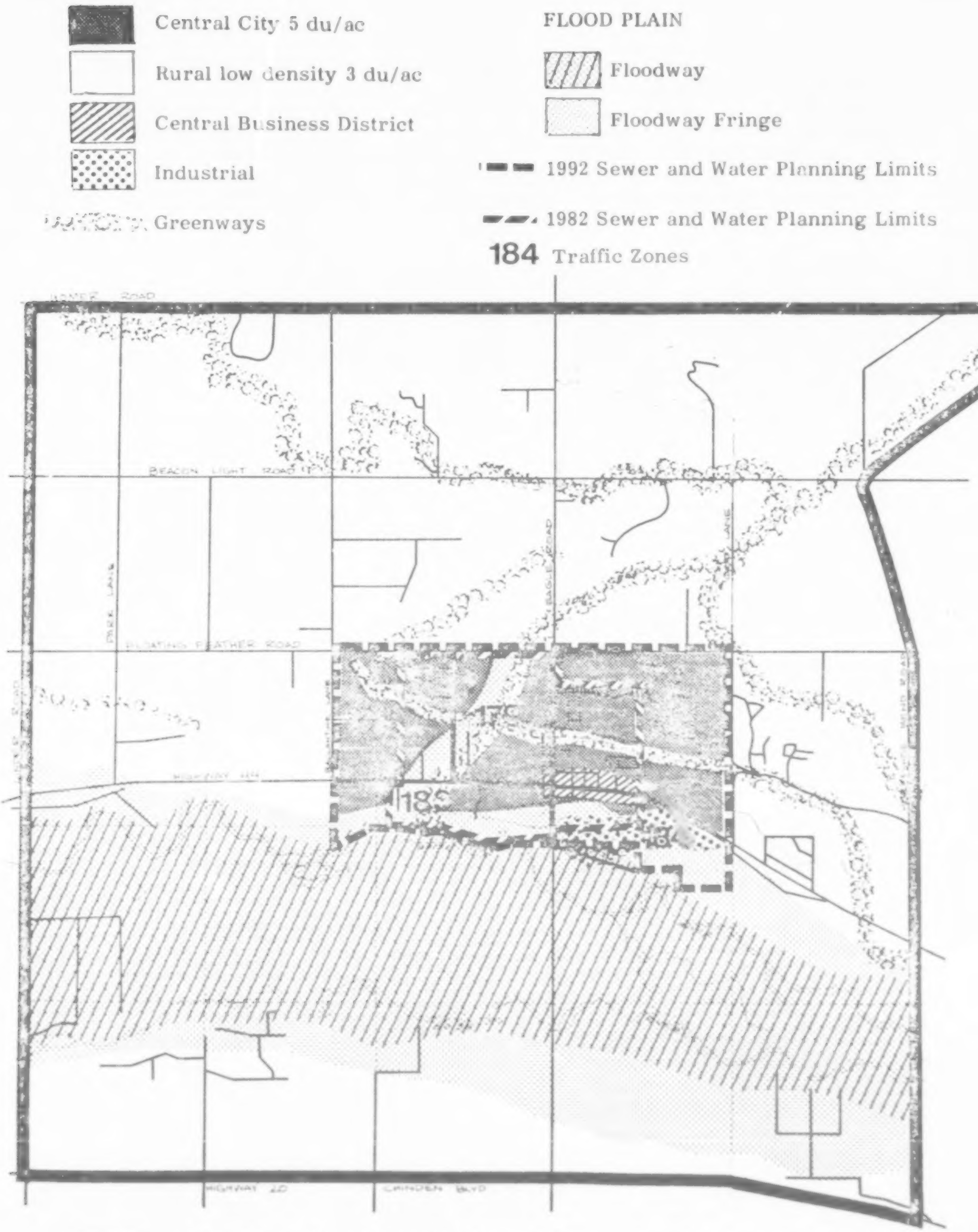
The methods used by APA are representative of those used by other councils of governments attempting to disaggregate a regional control total to subcounty planning areas. The DED report contains a particularly detailed documentation of methods and assumptions used to prepare the disaggregations. In general, the methods used to prepare the APA disaggregations have two potential drawbacks. Most importantly, they appear in some cases to assume that "build-out" (ultimate development) will occur at the year 2000;

Figure 2-2. Southwest Area


SOUTHWEST COMMUNITY
STUDY AREA
STAR
EAGLE
MERIDIAN
BOISE
KUNA
STUDY
AREA
N
STUDY AREA BOUNDRY

SOURCE: Ada Planning Association, 1979. Existing Conditions and Characteristics of Study Area.

Figure 2-3. Eagle Planning Area and Community Plan


Central City 5 du/ac
Rural low density 3 du/ac
Central Business District
Industrial
Greenways
FLOOD PLAIN
Floodway
Floodway Fringe
1992 Sewer and Water Planning Limits
1982 Sewer and Water Planning Limits
184 Traffic Zones
HOMER ROAD
BEACON LIGHT ROAD
FLOATING FEATHER ROAD
PARK LANE
EAGLE ROAD
HIGHWAY 44
175
183
184
HIGHWAY 20
CHINDEN BLVD

SOURCE: Ada Planning Association, 1978. Population and Employment Distribution to Year 2000: Ada County, Idaho.

the time phasing of achieving build-out is given insufficient attention. Secondly, the disaggregations are based on a "composite" of regional, county, local, and in some cases special district plans and policies, as well as recent trends and approved developments; conflicts among these policies, trends, and approved developments are likely, but these conflicts are generally not identified in the DED report.

Comparison with Recent Trends

Total Ada County Population. The DWR/BSU Series 2 Ada County population projection for 1980 is 166,347. (The first DWR/BSU projection, upon which the DED projection is based, indicated a 1980 population of 165,211.) Although a firm estimate of 1980 population will not be possible until the 1980 census data become available, recent rough estimates indicates the likelihood of a 1980 Ada County population of about 165,000-166,000. Ada Data, Inc., in its 1979 Boise Real Estate Research Report, estimated a 1978 population of 157,400. APA staff (pers. comm.) has estimated a mid-1979 population of about 160,000. These rough estimates are fairly consistent with a 1980 projection of 165,000-166,000, assuming the county continues to grow at an average annual increase of 6,040 people during the 1975-1980 interval as projected in the DWR/BSU projections.

Subdivision Trends by Planning Area. Table 2-4 compares 1975-1980 population growth projected in the DED projections with 1978-1979 subdivision plat data compiled by APA; this comparison allows a qualitative assessment of the extent to which subdivision activity has been consistent with projected population growth for each planning area.

The APA subdivision plat data fluctuate significantly from one 6-month reporting period to the next. Nevertheless, some overall conclusions are possible. From the data in Table 2-4, it is apparent that:

- Subdivision platting activity has been greater in 1978-1979 than would have been expected from the 1975-1980 DED population projection for west bench and Meridian.

- Subdivision platting activity has been less in 1978-1979 than would have been expected from the 1975-1980 DED population projection for north river, southeast, and Eagle.

Table 2-4. Comparison of Projected 1975-1980 Population Growth With 1978-1979 Subdivision Plat Data

Planning Area	1975[3] Population	1980[3] Population	Increase,[3] 1975-1980	% of[3] Increase	% Of Total Platted Lots[4]		
					7/78- 12/78	1/79- 5/79	6/79- 12/79
North River[1]	30,340	33,822	3,482	13.5	6.5	9.4	14.4
Northwest	5,310	7,853	2,543	9.9	0.4	0.2	22.3
West Bench	28,700	32,640	3,940	15.3	25.9	25.1	26.5
Central Bench	36,105	37,716	1,611	6.2	7.2	8.7	7.5
Southeast	11,425	17,319	5,894	22.8	16.1	26.3	10.5
Southwest[2]	9,080	12,071	2,991	11.6	16.3	4.4	0.2
Eagle	2,720	3,800	1,080	4.2	3.7	0.0	0.0
Meridian	6,349	8,920	2,571	10.0	19.3	20.7	16.6
Kuna	1,308	1,983	675	2.6	0.0	1.6	1.9
Rural Area	8,063	9,087	1,024	4.0	4.5	3.6	0.2
Total	139,400	165,211	25,811	100.1[5]	99.9[5]	100.0	99.9[5]

[1] North River except for northwest subarea.

[2] Includes airport planning area.

[3] SOURCE: Ada Planning Association, 1978. Demographic and Employment Distribution to Year 2000: Ada County, Idaho.

[4] SOURCE: Ada Planning Association. Ada County Recorded Subdivision Reports.

[5] Total does not add due to rounding.

- Subdivision platting activity in 1978-1979 has been about what could have been expected from 1975-1980 DED population projection for central bench, Kuna, and the rural area.

- No clear comparison is possible for northwest and southwest.

Overall, the data in Table 2-4 indicate a general consistency between the 1975-1980 projected population growth and 1978-1979 subdivision platting activity. This comparison must be qualified because it does not consider the build-out of subdivision plats approved prior to 1978. If pre-1978 plat data differ greatly from the 1978-1979 data, then subdivision trends and projected population growth over the 1975-1980 period may not agree as closely as indicated in Table 2-4.

Section 3

POTENTIAL ALTERNATIVE POPULATION PROJECTIONS FOR EIS ANALYSIS

This section presents various alternative population projections that could be used for EIS analysis. Separate sets of alternatives are presented for the Boise planning area, for the Southwest Area, for the Eagle planning area, and for Ada County as a whole. These alternatives are listed in Table 3-1. It is expected that some, but not all, of these alternatives will be selected for analysis in the EIS.

Boise Planning Area

It is only necessary to consider one population alternative for the Boise planning area. This is the projection developed by CH2M Hill in its Planning and Design Criteria Technical Memorandum. For the Boise planning area (defined as the Boise metropolitan area minus the Southwest Area, see Figure 3-1) initial population projections for total and sewered population are shown in Table 3-2.

This projection is intended by CH2M Hill to be based on the DED projection. However, a discrepancy exists between the two projections. For the year 2000, the DED projection for the Boise planning area would be 211,945, derived from subtracting the Southwest Area projection (22,380) from the total metro area projection (234,325). This DED projection is 6,815 lower than the CH2M Hill projection for the same area. CH2M Hill (pers. comm.) has indicated that the initial year 2000 projection of 218,760 was in error, and that the Boise planning area projection should be approximately 212,000.

Southwest Planning Area

APA 1979 Baseline

APA's 1979 baseline projection for the Southwest Area in the year 2000 is 29,390. Two density options have been

Table 3-1. List of Potential Population Alternatives for EIS Analysis

Boise Planning Area Alternatives

- CH2M Hill projection*

Southwest Planning Area Alternatives

- APA baseline (year 2000 = 29,390)
  - High density (4 dwelling units/acre)
  - Low density (2 dwelling units/acre)
- DED projection (year 2000 = 22,380)

Eagle Planning Area Alternatives

- DED projection (year 2000 = 10,255)
- "Middlebrook" projection (year 2000 = 16,000)**

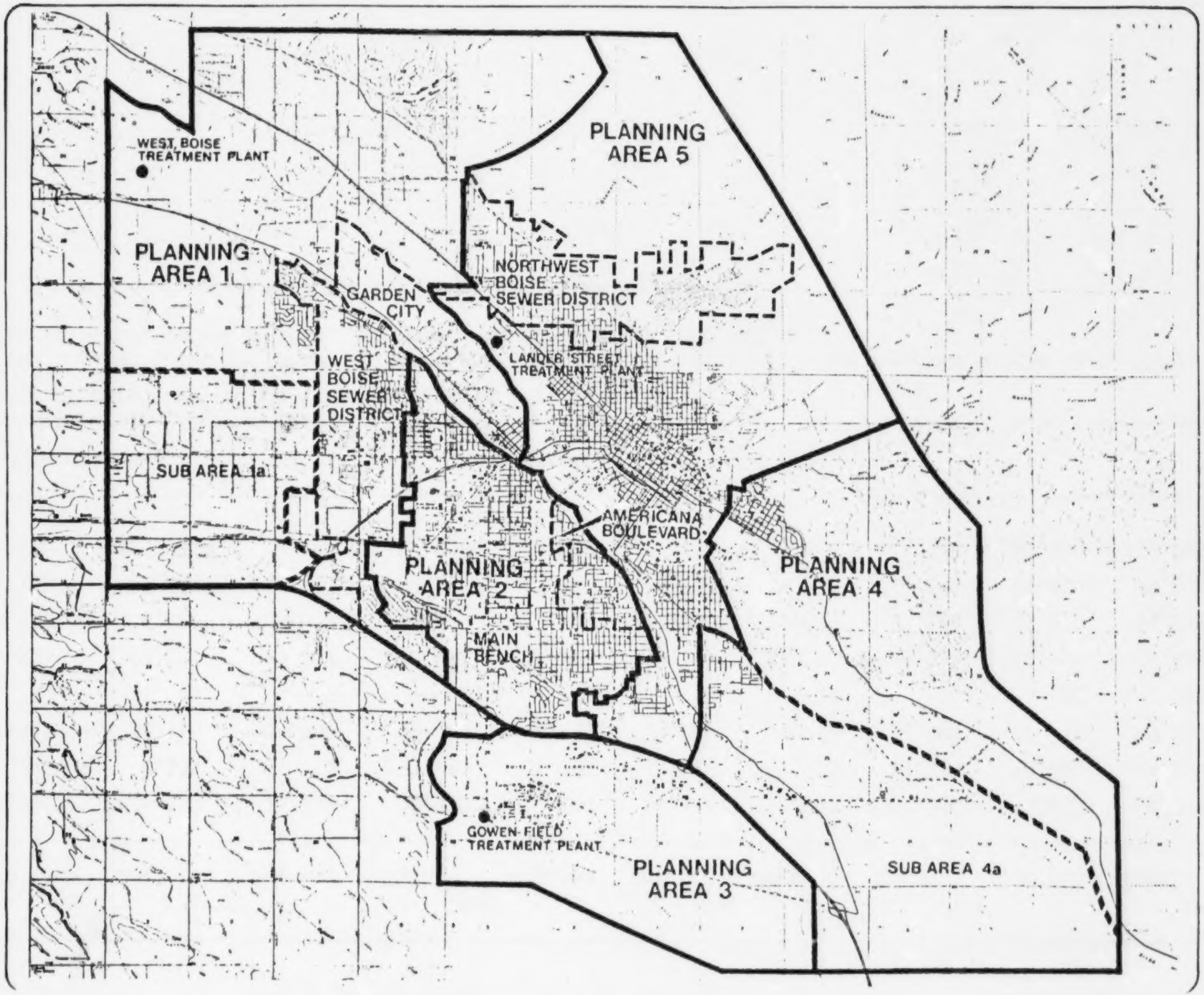
Countywide Alternatives

- APA baseline (year 2000 = 296,010)
  - Original distribution
  - Redistribute 5,745** from remainder of county to Eagle
  - "Middlebrook" projection (year 2000 = 301,765**)
- DED projection (year 2000 = 289,000)
  - Original distribution
  - Redistribute 7,010 from remainder of county to Southwest Area
  - Redistribute 12,755** from remainder of county to Southwest Area and Eagle

---

*Apparent discrepancy with DED projection, needs resolution
**Needs refinement

Figure 3-1. Boise Metropolitan Service Area and Planning Areas


WEST BOISE TREATMENT PLANT
PLANNING AREA 5
PLANNING AREA 1
NORTHWEST BOISE SEWER DISTRICT
GARDEN CITY
LANDER STREET TREATMENT PLANT
WEST BOISE SEWER DISTRICT
SUB AREA 1a
AMERICANA BOULEVARD
PLANNING AREA 2
PLANNING AREA 4
MAIN BENCH
GOWEN FIELD TREATMENT PLANT
PLANNING AREA 3
SUB AREA 4a

Reproduced from best available copy.

SOURCE: CH2M Hill, 1979. Planning and Design Criteria Technical Memorandum.

Table 3-2. Boise Planning Area Population Projections[1]

Planning Area	1975 Base	1979 Total	1979 Sewered	1985 Total	1985 Sewered	1990 Total	1990 Sewered	1995 Total	1995 Sewered	2000 Total	2000 Sewered
1*	31,940	35,010	15,245	46,090	30,580	54,145	40,205	61,950	53,625	66,790	66,790
Subarea 1A	6,295	8,135	0	9,080	4,600	10,665	7,155	12,205	10,200	13,155	13,155
2	31,015	31,410	28,700	33,060	31,125	33,200	31,910	34,000	33,355	35,685	35,685
3	40	40	0	40	0	45	45	50	50	55	55
4*	9,905	17,000	12,000	28,355	25,105	40,785	39,285	53,310	52,310	60,660	60,660
Subarea 4A	3,860	8,000	6,000	12,670	11,170	19,665	18,665	27,910	27,410	34,735	34,735
5	39,460	42,385	40,490	46,385	44,995	49,225	48,240	52,435	51,910	55,570	55,570
Totals	112,350	125,845	96,435	153,930	131,805	177,400	159,685	201,745	191,250	218,760	218,760

*Includes subarea populations.

[1] Total population data source "Demographic and Employment Distribution to Year 2000, Ada County, Idaho", Boise Metro areawide policies; prepared by the Ada Planning Association, August 1978.

Sewered population in 1979 based on "Boise Metropolitan Area Master Sewer Plan", map prepared by the Boise City Department of Public Works, December 1978, and actual sewer district connections.

SOURCE: CH2M Hill, 1979. Planning and Design Criteria Technical Memorandum.

developed to meet this projection, two dwelling units per acre and four dwelling units per acre. On December 13, the APA board adopted the high density alternative, which will be analyzed in the EIS. The low density alternative, although it has been rejected, could additionally be analyzed in the EIS.

DED Projection

APA's initial year 2000 projection for the Southwest Area in the DED report was 22,380. Although this projection has since been revised upward, it is still the adopted 208 plan projection, and could be analyzed as an alternative in the EIS.

Eagle Planning Area

DED Projection

The DED projection for Eagle for the year 2000 is 10,255. This alternative, which represents the adopted 208 plan projection, could be analyzed in the EIS.

"Middlebrook" Alternative

A working estimate of 16,000 for the year 2000 projection has been made for Eagle if the Middlebrook development is approved. This number would need to be refined further before being analyzed in the EIS. A major question is the extent to which population growth induced by the Middlebrook project would locate within the Eagle planning area, as compared to other locations in Ada County or in Canyon County.

Countywide Alternatives

APA Baseline

The revised Ada County baseline population projection for the year 2000 is 296,010; this incorporates the 7,010 added to the Southwest Area projection. This alternative should be analyzed in the EIS using the original DED distribution.

In addition, a new alternative could be analyzed which redistributes 5,745 people from the remainder of the county to Eagle. This alternative and any others requiring countywide distributions would need to be developed by APA staff.

"Middlebrook" Projection

The additional 5,745 people resulting from approval of the Middlebrook project could be added to the APA baseline total, creating a new county total of 301,755 for the year 2000.

DED Projection

APA's initial projection for Ada County was 289,000. Although this projection has since been revised upward, it is still the adopted 208 plan projection, and could be analyzed as an alternative in the EIS. Three distributional alternatives could be analyzed to meet the 289,000 projection: the original DED distribution; redistribution of 7,010 from the remainder of the county to the Southwest Area; and redistribution of 12,755 from the remainder of the county to the Southwest Area and to Eagle.

Section 4

ISSUES

Several issues are associated with the choice of population projections for analysis in the EIS. These include the following:

- Do the Middlebrook and Southwest Area population increases represent "new" growth?
- How will grant eligibility be determined?
- Are there other proposed major land developments which could affect population projections?

Do the Middlebrook and Southwest Area Population Increases Represent New Growth Beyond Prior Forecasts?

Gruen Gruen + Associates has analyzed the relationship between the population increases proposed for Middlebrook and the Southwest Area. Their full analysis appears in Appendix A and is summarized here.

With regard to Middlebrook employment, it is clear that the IPEF forecast of employment (upon which the DED projection is based) did not account for up to 7,500 jobs in the electronics industry in Ada County by the year 2000; it also did not account for jobs associated with the Hewlett Packard plant under construction. Between 1975 and 2000, the IPEF forecast of total job growth in the "other manufacturing" section (which includes the electronics industry) is only 3,815.

This does not necessarily mean that the overall IPEF forecast is too low, since low estimates in one sector can be offset by overestimates in another. Gruen Gruen + Associates believe that it is not possible to determine whether Middlebrook will generate "new" population and employment growth without more in-depth evaluation of total growth trends by sector in Ada County.

Regarding population increases in both Middlebrook and the Southwest Area, the general conclusion of Gruen Gruen + Associates is that if the overall population forecast for the county is accurate, then increases in one subcounty planning area imply decreases in the remaining planning areas. To state this conclusion in slightly different terms, adding additional population to a given planning area does not in itself affect the accuracy of the countywide population projection.

How Will Grant Eligibility Be Determined?

EPA's policy regarding grant eligible population projections was presented in Section 1. Unless the 208 plan is formally amended, grant eligibility for the design and construction of wastewater facilities will be based on the 208 plan DED population projections, assuming these are approved by EPA. Higher projections may, however, be analyzed in Step 1 facilities planning.

Are There Other Proposed Major Land Developments Which Could Increase Population Projections?

Preliminary contacts with planning agency staffs in Ada County have not indicated awareness of additional proposed major land developments (other than Middlebrook) which would call for reexamination of the DED population projections. This tentative conclusion will be verified as part of further work on the EIS.

APPENDIX A

Memorandum from Gruen Gruen + Associates

564 Howard Street
San Francisco
California 94105
(415) 433-7598

rvk

Date: January 31, 1980

Subject: Economic Evaluation of Proposed Population Increases in the Southwest Area and Middlebrook

From: Roberta Mundie
Gruen Gruen + Associates
Socioeconomic Consultants

To: Jones & Stokes Associates, Inc.
2321 "P" Street
Sacramento, California 95816

Our Understanding of the Issues

The Ada County Planning Association, in its August 1978 report titled *Demographic and Employment Distribution to Year 2000*, sets forth a forecast of population and land use distribution for county subareas, which in turn is based on previous county-wide employment and population forecasts, principally by the Idaho Department of Water Resources.

Two recent events have raised questions with regard to the continuing accuracy of the basic forecasts: (1) the proposal to construct a major employment, commercial and residential center called Middlebrook west of Boise and south of Eagle, and (2) an amendment to the 1978 population/land use projections adding 7,010 to the southwest area. The basic question is whether these increases - Middlebrook and Southwest - have been anticipated in and form part of the overall growth projection for the county in the DWR model.

The Southwest issues relate purely to population. The Middlebrook issues relate primarily to the adequacy of the employment forecast. This memorandum first reviews the forecasting model briefly, and then considers the employment and population issues posed by Middlebrook and the Southwest.

The IPEF Model and Its Local Application

The Ada County forecasts of employment and population were prepared using a computer-assisted model called the IPEF model, which means Idaho population and economic forecasting model. This model generates separate population and economic forecasts; then relates each to the other by comparing labor force estimates from the population outputs to labor force requirements from the employment outputs; then adjusts the population forecast by permitting a migration factor to change to bring labor force availability and need into balance. What the model produces is a forecast, at five-year intervals, of County employment and population to the year 2000. The Ada Planning Association drew primarily on the IPEF forecasts for the basic data it then applied in forecasting population by subareas of the County.

Two kinds of basic questions can be raised about the accuracy of the IPEF forecasts and their application: questions of *magnitude* and questions of *distribution*. The Middlebrook issues relate primarily to magnitude and the Southwest issues to distribution.

Middlebrook Employment

The proposed Middlebrook project, as described in a June 5, 1979 memorandum from the Ada County Zoning Department to the APA Board, would consist of about 250 acres of employment uses in a "technological park" and about 700-800 dwelling units, together with some commercial and public uses.

While the employment effects of the project will not be finally known until lease-up and occupancy, the intention of the developer is reportedly to establish a technological park on 250 acres. The tech park, if it has a character similar to the Hewlett-Packard project now under construction, would accommodate over 7,500 jobs in the electronics industry. This employment would be "basic" in the economist's terms because most of the production would be exported to markets outside the Boise region.

The question is whether the IPEF forecast anticipated this level of growth in the electronics industry, which is part of the "other manufacturing" sector in the forecast. Table 1 presents the IPEF forecast of employment in other manufacturing, of total employment and of population through the year 2000.

Table 1

IPEF Employment and Population Forecasts

	Other Manufacturing (excludes food & kindred and wood products sectors)		Total Employment	Population
	Number	% of Total		
1972 (base year)	3,044	5.3	57,085	120,600*
1975	2,861	4.2	67,529	136,140
1980	3,837	4.6	82,809	166,340
1985	4,430	4.6	95,495	192,380
1990	5,002	4.5	110,501	222,810
1995	5,773	4.5	127,712	254,800
2000	6,676	4.5	149,012	293,580

*1972 population estimate supplied by R. Meale to Jones & Stokes, verbal communication, June 25, 1979.

Source: Meale and Weeks, Population and Employment Forecast, State of Idaho, Series 2: Projections 1975-2000, published by Department of Water Resources and Boise State University, July 1978.

The first column of Table 1 shows employment in the other manufacturing sector of which Hewlett-Packard and other firms would be part. Between 1975 and 2000, employment growth in that sector is forecast at 3,815 jobs. That increase is not sufficient to cover the Hewlett-Packard employees, let alone 7,500 additional tech park job-holders. Based strictly on the sector forecast, it does not appear that IPEF incorporates this magnitude of growth.

The model can be adjusted to reflect this unanticipated change (of which 7,500 jobs are still only in the conceptual stage). That effort should supplement mathematical modeling with true field research looking into the comparative desirability of Boise as a manufacturing location for firms like Hewlett-Packard, as it seems evident that abstract formulations can overlook important alterations in a region's economic capacity.

Other aspects of the model can be re-examined at the same time. One important example is the employment-to-population ratio, which is held constant at about 0.5 jobs per 1.0 persons in the population throughout the 1975-2000 period. Most commentators believe we will continue to see a rising ratio during this period as we have in the recent past.

The failure of the model to account for sector growth does not necessarily mean that the overall employment estimate is too low. Low estimates in one sector may be offset by too-high estimates in others (for example, wood products employment is forecast to increase 550 percent between 1975 and 2000). But without a more in-depth evaluation of the model's assumptions and operations, it is not possible to reach a conclusion on this subject. Because employment and population are interactive, it is also not possible to reach a conclusion with regard to the magnitude of the population forecast.

The Southwest Area and Middlebrook Population

It is important to recognize that, while new jobs in basic industry *cause* growth, housing provision simply *accommodates* growth. The population housed in the new units, while they may affect the accuracy of this distribution projection, do not affect the accuracy of the population forecast itself. Thus, the projected 2,000 to 2,500 new residents in Middlebrook's 700 to 800 housing units and the 7,010 people added to the Southwest area in the amendment to the distribution plan do not alter the overall population forecast; they alter only the manner in which that population distributes itself on the land. If the overall population forecast is accurate - and that is a function of where jobs are, not where houses are - then a decision to add households to one area (or a recognition that more households want to move there than was previously anticipated) will be complemented by a downward shift in the number of households in other areas.

There are two major influences on such population distribution: public policy and consumer preferences. In certain highly-regulated areas, where the demand for housing clearly exceeds the potential supply, it is sufficient to know the capacity of the land under current zoning to forecast housing unit provision, and therefore population. In a situation such as Ada County's, however, this highly restrictive condition does not appear to exist, and the housing consumer may have a number of choices with regard to residence location. Under these circumstances, such factors as consumer preferences (which reflect, among other things, varying land costs among different communities and variations in neighborhood character and conditions) must also be consulted to help make a distribution plan more accurate.

Unresolved Issues

The most important hidden question which Middlebrook poses is, how much more economic growth unanticipated by IPEF's sector analysis is likely to take place? Simply adjusting the current forecast to add in 12,500 electronics jobs by 1990 is quick band-aid approach, but only a more thorough review of the forecast can help shed light on what other changes from past conditions Boise can expect in the future.

BIBLIOGRAPHY

Persons Consulted

Barker, S. January 1980. CH_2M Hill, Boise.

Minter, R. January 1980. Ada County Planning Association, Boise.

Reference Documents

Ada County Planning Association. 1978. Demographic and employment distribution to the year 2000. Boise.

Idaho. Dept. of Water Resources. 1978. Population and employment forecast, State of Idaho, series 2: projections 1975-2000. Prepared with Boise State University.

Appendix D

DRAINAGE

Prepared by:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

January 1981

TABLE OF CONTENTS

	Page
Appendix D - DRAINAGE	D-1
Introduction	D-1
Nature and History of the Problem	D-1
Impacts	D-6
Recommended Mitigations	D-6
BIBLIOGRAPHY	D-8

Appendix D

DRAINAGE

Introduction

The following discussions of the drainage situation in Ada County are excerpted from the Drainage Task Report in drainage planning and institutional evaluation, which is a separate task report by Jones & Stokes Associates, prepared as part of this EIS. The task report was widely distributed to drainage and regional planning agencies in February 1980, and was discussed at a workshop in March 1980. The report is available in the EPA district office in Boise.

Nature and History of the Problem

The problems are currently manifested by flooding with property damage during heavy storms; overflow of the irrigation canals and ditches which intercept runoff from urbanizing rural areas; concern by irrigation districts regarding urban pollutants in runoff water; varying quality and effectiveness of drainage facilities installed by developers; damage to, failure of, and nuisance conditions from unmaintained drainage facilities; and vocal concern about present and future drainage problems by local government officials. In the future these problems are likely to intensify as new areas, particularly the Southwest area, are urbanized.

The problems are complicated by the complex drainage patterns that have evolved in conjunction with the irrigation canals and ditches, particularly in the Southwest area of the county. Irrigation canals divert water from the Boise River, and convey that water to the bench lands away from the river. Natural drainage courses flow generally toward the river, perpendicular to the irrigation canal. Historically, most of the drainage has been intercepted in the irrigation canals, since the amount of runoff from the relatively pervious soil is usually small and was handled with no difficulty.

As urban growth changes the land uses in Ada County, however, the runoff from rainfall and snowmelt has fewer opportunities to percolate into the soil. As a result the volume of runoff tends to increase and concentrate faster from urbanized areas than from rural areas. This increased peak runoff tends to swell the flow in natural drainage courses and irrigation canals, overflowing canals and laterals. Increased storm runoff and runoff from lawn irrigation and other urban activities tend to keep the irrigation canals flowing during most of the year, inhibiting maintenance activities.

Water quality problems are likely to result from greater quantities of urban pollutants entering the irrigation system. It is possible that pesticides, heavy metals and other substances could enter the food chain through irrigation with untreated urban runoff. The magnitude of such a threat is difficult to determine.

In the Southwest area, the prospective development of either low or high density residential land uses promises to aggravate the problems of flooding and overloading of irrigation canals, with resulting property damage, interference with irrigation operations, and strained relations between governmental agencies and their constituents.

In the area along the foot of the Boise Front, development is pushing into the foothills, providing more permanent driveway and roof areas, and increasing the runoff tributary to older areas of the city. During storms the downstream facilities may become overloaded and flooding and property damage may occur. As in the Southwest area, urban runoff also enters the irrigation canals. These problems are also likely to intensify as more homes are built along the front. Erosion and deposition of sediment in drainage facilities is a particularly serious problem in the developing foothill areas.

Within the City of Boise, many of the older drainage facilities are undersized and/or deteriorated, and even new facilities tend to become overloaded from increased runoff from developing tributary areas. Inadequate records of the location, sizing and existence of storm drains further complicates the problem.

No areawide approach to the solution and prevention of these drainage problems presently exists. A master drainage plan (JUB Engineers et al. 1973) was proposed for the entire area in 1973 and adopted by Ada Council of Governments (ACOG), the predecessor of Ada Planning Association (APA). However, the plan was never adopted by the city, county or special district agencies responsible for managing development. The plan emphasizes a tempered structural solution to drainage needs; that is, conventional storm drainage pipes, with detention ponds to reduce peak flows. One variation of the plan proposed discharging some runoff to irrigation canals, while the other proposed to keep the waters separate to a significant degree. The costs were estimated at $21,390,000 and $23,470,000, respectively, in 1973 dollars.

Ada County has required each new development in the unincorporated areas to provide for its own drainage needs, following the approach of retarding flows and releasing drainage water at the same quality and rate of discharge as occurred prior to development. The responsibility to oversee the design and construction of the drainage facilities has largely rested with the County Engineer. The cities and irrigation districts, which have review authority, had delegated much of this authority to the County Engineer.

In August 1979 the County Engineer gave back most of his drainage review authority to the underlying local agencies (cities and irrigation districts). He retains review authority over unincorporated areas not within the irrigation districts. This has further fragmented the provision of drainage facilities in unincorporated areas, although the irrigation districts had previously been involved in drainage to some degree. Subsequently, in October 1980, the City of Boise delegated its drainage review authority to the Ada County Highway District.

When the irrigation districts reviewed development proposals in the past they generally balked at accepting any new quantities of runoff water from urban development. The districts were concerned both with degraded quality and with increased flow rates. The irrigation districts do provide drainage services which may be interpreted as the removal of excess applied irrigation water, and also as the removal of normal rainfall and snowmelt runoff. But the districts have generally refused to accept direct urban runoff. When the peak flows are reduced to a rate equivalent to natural runoff and some treatment is accomplished in detention basins or overland flow, the districts have usually approved the development plans.

Under the current approach, each developer's engineer designs a drainage system to achieve the discharge objectives, generally incorporating some form of on-site retention or detention pond. A variety of facilities exists, and their relative success varies. Most importantly, once the developer has completed construction there is usually no apparent maintenance by developers. The developer may continue to hold title to the land occupied by retention or detention ponds, although if he fails to pay the property taxes, the land reverts to county ownership. No agencies have been willing to accept title to these facilities. In many cases a property owner's association is formed with one of its duties being the maintenance of these drainage ponds; however, rarely do these associations function properly to carry out this maintenance.

The Ada County Highway District (ACHD) has in the past performed some maintenance, but the agency does not have funding or legal authority to assume these maintenance responsibilities at present. As a result of tax limitation legislation, the ACHD budget has been reduced, eliminating even occasional maintenance of any drainage facilities except those associated with county highways.

There are many small subdivision areas along the Boise Front and in the Southwest area that have been developed with retention pond facilities in the last few years. Most of these ponds are not maintained; they exhibit this lack of maintenance in erosion, decreased capacity, furtively dumped solid waste, and weeds and brush that constitute a fire hazard.

In the Southwest area relatively flat conditions prevail and the ponds tend to be continuously wet from surplus lawn irrigation, car washing and other outdoor water uses. Weed growth and mosquitos tend to be problems associated with these ponds. Silts and sediments, as well as organic debris from vegetative growth tend to fill the ponds and decrease storage capacity. Wet ponds with aquatic growth may support some wildlife that otherwise would be absent from the urban fringe areas. The ponds tend to be an attractive nuisance and could attract children. The potential for drownings and injuries related to pond use does exist, even when the ponds are fenced. Many fences are improperly designed, constructed, and maintained. Access to ponds for maintenance is often difficult, and pond construction itself may make maintenance difficult.

Inconsistencies in drainage design criteria between agencies contribute to fragmented solutions. The 1973 master plan (ACOG 1973) proposed use of flood recurrence criteria of once in 5, 10, 50 and 100 years depending on land use or watershed. This can lead to arbitrary expansion and contraction of capacity as a storm drain passes through areas of various land uses. City of Boise law requires use of a 50-year design storm, but this has been largely ignored in favor of the criteria adopted in the 208 plan Urban Runoff Control Handbook (CH2M Hill, Inc. 1977). Those latter criteria propose use of 5-, 10- and 25-year return storms depending on land use. The County Engineer has also used these criteria for the last few years, and it is expected that the irrigation districts will also apply them to projects under their review. The City of Boise is presently reviewing its criteria.

The Flood Insurance Act of 1968 requires protection and property improvements from a 100-year frequency storm and provides for the preparation of maps delineating areas of flood risk, seeks to prohibit new property improvements within flood hazard areas (unless protected by effective flood proofing measures), and provides a means of obtaining insurance to cover flood risk exposure of existing improvements. This federally-mandated program is being implemented in Ada County through preparation of the flood hazard maps, implementation of floodplain regulations and provision of floodplain insurance. The flood hazard maps, however, follow major existing streams and the Boise River only, and do not delineate the flood hazards from 100-year floods in much of the Southwest area and in some of the front area. It is probable that continuing development of the unincorporated area of the county under 5-, 10-, and 25-year design criteria will inevitably expose new property improvements to flood damage from 100-year events.

In conclusion, the principal drainage problems are perceived as:

- Flooding and property damage from inadequately handled runoff.
- Overflow of irrigation canals and ditches due to increased urban runoff.
- Probable increase in pollutants in irrigation canals and other surface waters due to increased urban runoff.
- Inadequate function of existing drainage systems.
- Development of nuisance conditions at retention and detention ponds due to lack of maintenance.
- An intensification of these problems accompanied by public dissatisfaction as urban development continues.

The basic causes of these problems are perceived as:

- Lack of areawide drainage planning.
- An uncoordinated piecemeal approach to drainage on a development-by-development basis.
- Lack of an areawide agency or group of agencies with effective control of drainage management.
- Lack of consistent and adequate criteria for storm drainage design and 100-year flood flow planning.
- Lack of maintenance for existing drainage facilities.
- Lack of funding for planning, facility implementation, maintenance and administration.

Impacts

Through increased sewage capacity and land use planning, the stage appears set for additional development to occur in Ada County. Based on current drainage planning and institutional responsibility a likely future scenario can be projected. It is likely that a large number of retention ponds will be built, each designed to serve an increment of the development. The irrigation districts in some cases are likely to perform thorough reviews and in other cases incomplete reviews. As time goes on, the unmaintained ponds are likely to become nuisances, helping to breed mosquitos, causing weed growth, constituting safety hazards, filling with sediment and debris and failing to operate when needed most. Property damage from flooding will be very likely during moderate to heavy storms; irrigation canals will be overloaded and will likely suffer more frequent damage with the irrigation districts possibly bypassing runoff to lands that have been protected from upstream runoff for decades.

Governmental agencies at all levels will be increasingly pressured by their constituents to solve the problems. The funding will probably have to come from these same constituents to provide makeshift solutions, and hopefully, some consistent areawide solution to the storm drainage problems. By the time events have run their course to this point it is likely that expensive underground storm drain pipes and concrete-lined channels will be the only feasible solution. Costs of $5,000-$10,000 per acre are not unusual for such systems.

While the above scenario may seem extreme to some, it has been repeated with many different variations in many areas of the country. Southern California and suburban Seattle are typical examples of areas where many older communities faced expensive flood protection costs to correct inadequate construction in earlier years. There, many of these flood control costs were borne by residents during later years, rather than as a development cost when the areas were first urbanized.

Recommended Mitigations

The adverse impacts of new development within the physical and institutional environment related to drainage in Ada County can be mitigated by implementing a number of measures. EPA may consider these mitigations for inclusion as grant conditions on funding for the facilities covered by this EIS.

- Designate an agency, preferably the ACHD, (secondarily Ada County or thirdly a new entity) and possibly including the incorporated cities, to implement countywide drainage planning, facility implementation, maintenance and administration.

- Seek legislative clarification to provide full drainage authority and funding to the agency for all appropriate functions.

- Develop, adopt and implement consistent drainage criteria for storm drain design and for provision of flow routes for runoff from the 100-year event without property damage consistent with the National Flood Insurance Act.

- Prepare, adopt and implement drainage master plans indicating flow volumes for storm drain design and 100-year flood flows, and specifying facilities or concepts. The plans should provide for funding, and should involve a consistent approach to the separation or combination of storm drains with irrigation facilities.

BIBLIOGRAPHY

Reference Documents

CH2M Hill, Inc. 1977. Urban runoff control handbook for Ada and Canyon Counties. Prepared for Ada/Canyon Waste Treatment Management Commission. 46 pp. + tables + figs.

Jones & Stokes Associates, Inc. 1980. Draft drainage task report: drainage planning and institutional evaluations. Prepared for U.S. Environmental Protection Agency. 51 pp.

J-U-B Engineers, Inc., and Barton, Stoddard, Milhollin & Higgins. 1973. Boise metropolitan area storm sewer system general plan. Prepared for Ada Council of Governments. 48 pp. + tables + appendix + figs.

Appendix E

PARTIAL SPECIES LIST

Ada County

Prepared by:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

July 1980

Partial List of Plants and Animals Occurring in Ada County[1]

Common Name	Scientific Name
PLANTS	
Horsetail	*Equisetum* spp.
Ponderosa pine	*Pinus ponderosa*
Douglas-fir	*Pseudotsuga menziesii*
Cattail	*Typha latifolia*
Arrowhead	*Sagittaria cuneata*
Bluebunch wheatgrass	*Agropyron spicatum*
Crested wheatgrass	*A. cristatum*
Cheatgrass	*Bromus tectorum*
Bermuda grass	*Cynodon dactylon*
Idaho fescue	*Festuca idahoensis*
Foxtail barley	*Hordeum jubatum*
Indian ricegrass	*Oryzopsis hymenoides*
Rabbitfoot grass	*Polypogon monspeliensis*
Needle-and-thread	*Stipa comata*
Three-awn	*Aristida longiseta*
Bulrush	*Scirpus* spp.
Sedge	*Carex* spp.
Hanna Aase's onion	*Allium aaseae*
Cottonwood	*Populus* spp.
Willow	*Salix* spp.
Four-winged saltbrush	*Atriplex canescens*
Shadscale	*A. confertifolia*
Greasewood	*Sarcobatus vermiculatus*
Russian thistle	*Salsola kali*
Currant	*Ribes viscossimum*
Wild rose	*Rosa woodsii*
Mulford's milkvetch	*Astragalus mulfordae*
Bitterbrush	*Purshia tridentata*
Big sagebrush	*Artemesia tridentata*
Rabbitbrush	*Chrysothamnus* spp.

Common Name	Scientific Name	Abundance[2]			
		Spring	Summer	Fall	Winter
ANIMALS					
Mammals					
Spotted bat	*Euderma maculatum*	Rare[3]			
Mountain cottontail	*Sylvilagus nuttallii*	L	L	L	L
Black-tailed jackrabbitt	*Lepus californicus*	L	L	L	L

Cont'd.

Common Name	Scientific Name	Abundance[2]			
		Spring	Summer	Fall	Winter
Snowshoe hare	*Lepus americanus*	L	L	L	L
Least chipmunk	*Eutamias minimus*	M	M	M	M
Yellow-bellied marmot	*Marmota flaviventris*	L	L	L	L
White-tailed antelope squirrel	*Ammospermophilus leucurus*	M	M	M	M
Townsend ground squirrel	*Spermophilus townsendi*	M	M	M	M
Golden-mantled ground squirrel	*Citellus lateralis*	L	L	L	L
Red squirrel	*Tamiasciurus hudsonicus*	L	L	L	L
Pocket gopher	*Thomomys* spp.	M	M	M	M[4]
Ord kangaroo rat	*Dipodomys ordi*	M	M	M	M[4]
Deer mouse	*Peromyscus maniculatus*	M	M	M	M[4]
Bushy-tailed woodrat	*Neotoma cinerea*	L	L	L	L[4]
Muskrat	*Ondatra zibethica*	L	L	L	L
House mouse	*Mus musculus*	M	M	M	M
Porcupine	*Erethizon dorsatum*	L	L	L	L
Coyote	*Canis latrans*	M	M	M	M
Kit fox	*Vulpes macrotis*	L	L	L	L
Raccoon	*Procyon lotor*	L	L	L	L
Badger	*Taxidea taxus*	M	M	M	M
River otter	*Lutra canadensis*	L	L	L	L
Striped skunk	*Mephitis mephitis*	L	H	L	L
Bobcat	*Lynx rufus*	L	L	L	L
Elk	*Cervus elaphus*	L	L	L	L
Mule deer	*Odocoileus hemionus*	M	M	M	H
Birds					
White pelican	*Pelecanus erythrorhynchos*	L	L	L	P
Great blue heron	*Ardea herodias*	L	L	L	L
Black-crowned night heron	*Nycticorax nycticorax*	L	L	L	L
Canada goose	*Branta canadensis*	L	M	M	L
Mallard	*Anas platyrhynchos*	M	M	M	M
Green-winged teal	*A. crecca*	M	M	M	M
Blue-winged teal	*A. discors*	L	M	M	L
American wigeon	*A. americana*	M	M	M	M
Sharp-shinned hawk	*Accipiter striatus*	L	L	L	L
Red-tailed hawk	*Buteo jamaicensis*	M	M	M	M
Swainson's hawk	*B. swainsoni*	L	L	L	L
Ferruginous hawk	*B. regalis*	L	L	L	L
Golden eagle	*Aquila chrysaetos*	L	L	L	L
Bald eagle	*Haliaeetus leucocephalus*	L	L	L	L
Marsh hawk	*Circus cyaneus*	L	L	L	L
Osprey	*Pandion haliaetus*	L	L	L	L
Prairie falcon	*Falco mexicanus*	L	L	L	L
Peregrine falcon	*F. peregrinus*	Rare[3]			
Kestrel	*F. sparverius*	M	M	M	M
Blue grouse	*Dendragapus obscurus*	L	L	L	L
Ruffed grouse	*Bonasa umbellus*	L	L	L	L
Sharp-tailed grouse	*Pedioecetes phasianellus*	L	L	L	L
Sage grouse	*Centrocercus urophasianus*	L	L	L	L
Bobwhite quail	*Colinus virginianus*	L	L	L	L
Mountain quail	*Oreortyx pictus*	L	P	P	P
California quail	*Lophortyx californicus*	L	L	L	L

Cont'd.

Common Name	Scientific Name	Abundance[2]			
		Spring	Summer	Fall	Winter
Ring-necked pheasant	Phasianus colchicus	M	M	M	M
Chukar partridge	Alectoris chukar	L	L	L	L
Hungarian partridge	Perdix perdix	L	L	L	L
Killdeer	Charadrius vociferus	M	M	M	M
Long-billed curlew	Numenius americanus	L	L	L	P
American avocet	Recurvirostra americana	L	L	L	L
California gull	Larus californicus	M	M	M	L
Rock dove (domestic pigeon)	Columba livia	Common[3]			
Mourning dove	Zenaida macroura	M	M	M	L
Burrowing owl	Athene cunicularia	L	M	M	L
Common nighthawk	Chordeiles minor	L	L	L	L
Belted kingfisher	Megaceryle alcyon	L	L	L	L
Common flicker	Colaptes auratus	L	L	L	L
Western kingbird	Tyrannus verticalis	L	M	L	L
Horned lark	Eremophila alpestris	L	M	M	L
Black-billed magpie	Pica pica	M	M	M	M
Common raven	Corvus corax	M	M	M	M
Common crow	Corvus brachyrhynchos	M	M	M	M
Mountain chickadee	Parus gambeli	L	L	L	L
Red-breasted nuthatch	Sitta canadensis	L	L	L	L
House wren	Troglodytes aedon	L	M	L	L
Robin	Turdus migratorius	M	M	M	L
Mountain bluebird	Sialia currocoides	L	L	L	L
Cedar waxwing	Bombycilla cedorum	L	L	L	L
Loggerhead shrike	Lanius ludovicianus	L	M	L	L
Starling	Sturnus vulgaris	M	M	M	M
Warbling vireo	Vireo gilvus	M	M	M	P
House sparrow	Paser domesticus	M	M	M	M
Western meadowlark	Sturnella neglecta	M	M	M	M
Yellow-headed blackbird	Xanthocephalus xanthocephalus	M	M	L	L
Red-winged blackbird	Agelaius phoeniceus	M	M	L	L
Brewer's blackbird	Euphagus cyanocephalus	L	L	L	L
Pine siskin	Spinus pinus	L	L	L	L
American goldfinch	Carduelis tristis	L	M	L	L
Rufous-sided towhee	Piplio erythrophthalmus	M	M	M	L
Savannah sparrow	Passerculus sandwichensis	M	M	M	L
Grasshopper sparrow	Ammodramus savannarum	L	M	M	L
Chipping sparrow	Spizella passerina	L	M	M	L
Reptiles					
Western terrestrial garter snake	Thamnophis elegans	M	M	M	M
Common garter snake	T. sirtalis	M	M	M	M
Western ground snake	Sonora semiannulata	M	M	M	M
Desert night snake	Hypsiglena torquata deserticola	M	M	M	M
Western rattlesnake	Crotalus viridis	M	M	M	M
Western fence lizard	Sceloporus occidentalis	M	M	M	M
Sagebrush lizard	S. graciosus	H	H	H	H
Amphibians					
Leopard frog	Rana pipiens	M	M	M	M
Spotted frog	R. pretiosa	M	M	M	M

Cont'd.

[1] SOURCES: Peterson 1961; Stebbins 1966; Holmgren 1972; Ada Council of Governments 1973a; Burt and Grossenheider 1976; Idaho Department of Fish and Game 1977; U. S. Bureau of Land Management 1980.

[2] Abundance from Idaho Department of Fish and Game 1977.

H = High L = Low
M = Medium P = Population level unknown

[3] Abundance of this species not listed by Idaho Department of Fish and Game (1977). Abundance shown on this table taken from U. S. Bureau of Land Management (1980).

[4] Idaho Department of Fish and Game (1977) did not list abundances of individual species of gophers, kangaroo rats, white-footed mice, and woodrats. Abundance shown is that listed for the species group.

Appendix F

HOURLY CARBON MONOXIDE EMISSIONS BY COMMUNITY PLANNING AREA: 1977, 1980, 1987, AND 2000

Prepared by:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

February 1981

Table F-1. Hourly Carbon Monoxide Emissions Summary for 1977

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds)																								Average Winter Daily Emissio (Pounds)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Southeast Area (10)	Highway Traffic	287	181	90	60	60	121	441	2,701	2,586	1,969	2,094	2,447	2,721	2,612	2,476	2,654	2,939	2,983	1,484	1,204	977	959	776	551	35,375
	Parking	46	29	0	0	0	7	22	653	635	254	403	346	348	500	348	373	463	454	322	362	271	141	212	172	6,353
	Residential Fuels	186	186	186	186	186	186	626	626	626	626	626	626	421	421	421	421	421	421	1,119	1,119	1,119	1,119	1,119	1,119	14,111
	Total	519	396	276	246	246	314	1,089	3,980	3,847	2,849	3,123	3,419	3,490	3,533	3,245	3,448	3,823	3,858	2,925	2,685	2,367	2,219	2,107	1,842	55,840
Northwest Subarea (21)	Highway Traffic	128	86	42	29	29	57	209	1,702	1,594	1,111	1,173	1,382	1,519	1,466	1,396	1,506	1,673	1,698	728	591	465	448	368	271	19,674
	Parking	0	0	0	0	0	0	0	276	282	119	190	165	157	194	128	128	126	123	112	104	66	9	0	0	2,174
	Residential Fuels	80	80	80	80	80	80	270	270	270	270	270	270	182	182	182	182	182	182	483	483	483	483	483	483	6,085
	Total	208	166	122	109	109	137	479	2,248	2,146	1,500	1,633	1,817	1,858	1,842	1,706	1,816	1,981	2,003	1,323	1,178	1,014	940	851	754	27,933
CBD Subarea (22)	Highway Traffic	675	414	207	139	139	278	1,010	5,289	5,124	4,114	4,396	5,124	5,743	5,501	5,187	5,551	6,195	6,307	3,342	2,703	2,231	2,207	1,770	1,239	74,882
	Parking	24	2	2	2	2	4	31	408	522	384	560	642	763	849	752	747	1,049	842	397	390	344	128	24	15	8,880
	Residential Fuels	78	78	78	78	78	78	264	264	264	264	264	264	178	178	178	178	178	178	473	473	473	473	473	473	5,958
	Total	777	494	287	219	219	358	1,305	5,961	5,910	4,762	4,914	6,030	6,684	6,528	6,117	6,476	7,422	7,327	4,212	3,566	3,048	2,808	2,267	1,727	89,720
Warm Springs Subarea (23)	Highway Traffic	62	40	20	13	13	26	97	679	644	472	500	586	648	624	591	637	703	708	333	271	216	212	172	123	8,391
	Parking	0	0	0	0	0	0	0	209	205	64	90	68	55	88	37	37	104	97	26	26	0	0	0	0	1,109
	Residential Fuels	55	55	55	55	55	55	184	184	184	184	184	184	124	124	124	124	124	124	329	329	329	329	329	329	4,141
	Total	117	95	75	68	68	81	281	1,072	1,033	720	774	832	827	836	752	798	931	929	688	626	545	541	501	452	13,642
Foothills Subarea (24)	Highway Traffic	51	33	15	11	11	22	82	549	520	384	406	476	527	507	481	518	571	575	273	220	179	172	141	101	6,821
	Parking	0	0	0	0	0	0	0	384	373	117	168	121	99	157	60	62	154	148	51	53	0	0	0	0	1,942
	Residential Fuels	95	95	95	95	95	95	321	321	321	321	321	321	216	216	216	216	216	216	575	575	575	575	575	575	7,244
	Total	146	128	110	106	106	117	403	1,254	1,214	822	895	918	842	880	757	796	941	939	899	848	754	747	716	676	16,007
Northend Subarea (25)	Highway Traffic	315	201	101	66	60	134	492	3,210	3,060	2,277	2,418	2,833	3,139	3,020	2,864	3,075	3,408	3,448	1,662	1,347	1,087	1,063	862	617	40,768
	Parking	0	0	0	0	0	0	4	928	908	311	445	342	300	445	190	188	251	234	163	165	31	13	4	0	4,925
	Residential Fuels	278	278	278	278	278	278	936	936	936	936	936	936	630	630	630	630	630	630	1,675	1,675	1,675	1,675	1,675	1,675	21,120
	Total	593	479	379	344	338	412	1,432	5,074	4,904	3,524	3,799	4,111	4,069	4,095	3,684	3,893	4,289	4,312	3,500	3,187	2,793	2,751	2,541	2,292	66,813
West Bench Area (30)	Highway Traffic	891	580	291	201	247	516	1,574	10,064	9,458	6,711	7,042	8,270	9,136	8,785	8,424	9,125	10,254	10,348	4,747	3,836	3,075	2,965	2,436	1,784	120,752
	Parking	2	2	0	0	0	2	18	1,484	1,523	690	1,091	1,047	1,085	1,301	922	933	1,109	1,014	639	626	395	128	68	35	14,116
	Residential Fuels	383	383	383	383	383	383	1,289	1,289	1,289	1,289	1,289	1,289	867	867	867	867	867	867	2,306	2,306	2,306	2,306	2,306	2,306	29,077
	Total	1,276	965	674	584	630	901	2,881	12,837	12,270	8,690	9,422	10,606	11,088	10,953	10,213	10,925	12,230	12,229	7,692	6,768	5,776	5,399	4,810	4,125	163,945
Central Bench Area (40)	Highway Traffic	919	589	295	209	295	633	1,731	9,026	8,479	6,127	6,382	7,463	8,281	7,930	7,654	8,331	9,493	9,619	4,665	3,757	3,067	2,963	2,423	1,770	112,101
	Parking	49	11	9	9	9	15	22	1,865	1,903	765	1,175	1,063	1,041	1,325	820	829	1,056	948	589	562	260	110	88	37	14,562
	Residential Fuels	500	500	500	500	500	500	1,683	1,683	1,683	1,683	1,683	1,683	1,133	1,133	1,133	1,133	1,133	1,133	3,011	3,011	3,011	3,011	3,011	3,011	37,963
	Total	1,468	1,100	804	718	804	1,148	3,436	12,574	12,065	8,575	9,240	10,209	10,455	10,388	9,607	10,293	11,682	11,700	8,265	7,330	6,338	6,084	5,522	4,818	164,626

Table F-1 (cont'd.)

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Average Winter Daily Emissions (Pounds)
Southwest Area (50)	Highway Traffic	481	317	159	115	170	370	970	5,756	5,344	3,646	3,774	4,433	4,883	4,689	4,553	4,982	5,670	5,706	2,557	2,059	1,651	1,574	1,305	977	66,14
	Parking	15	15	11	13	4	18	29	505	514	225	340	315	304	370	262	264	430	432	185	185	126	60	31	24	4,678
	Residential Fuels	119	119	119	119	119	119	402	402	402	402	402	402	270	270	270	270	270	270	719	719	719	719	719	719	9,058
	Total	615	451	289	247	293	507	1,401	6,663	6,260	4,273	4,516	5,150	5,457	5,329	5,085	5,516	6,370	6,408	3,461	2,963	2,496	2,353	2,055	1,720	79,879
Boise Metropolitan Area Subtotal	Highway Traffic	3,809	,441	1,220	843	1,024	2,157	6,606	38,976	36,809	26,811	28,185	33,014	36,597	35,134	33,626	36,379	40,906	41,392	19,791	15,988	12,948	12,563	10,253	7,433	484,997
	Parking	137	60	22	24	15	46	126	6,711	6,865	2,928	4,462	4,109	4,151	5,229	3,519	3,560	4,742	4,292	2,485	2,474	1,493	589	428	284	58,74
	Residential Fuels	1,774	,774	1,774	1,774	1,774	1,774	5,975	5,975	5,975	5,975	5,975	5,975	4,020	4,020	4,020	4,020	4,020	4,020	10,689	10,689	10,689	10,689	10,689	10,689	134,755
	Total	5,720	,275	3,016	2,641	2,813	3,977	12,707	51,662	49,649	35,714	38,622	43,098	44,768	44,383	41,165	43,959	49,668	49,704	32,965	29,151	25,130	23,841	21,370	18,406	678,40
Meridian (60)	Highway Traffic	196	128	64	42	42	86	315	2,423	2,286	1,618	1,713	2,013	2,218	2,138	2,035	2,191	2,416	2,432	1,087	884	699	675	556	403	28,667
	Parking	0	0	0	0	0	0	0	320	309	99	143	101	82	130	42	44	44	46	46	46	0	0	0	0	1,457
	Residential Fuels	93	93	93	93	93	93	313	313	313	313	313	313	211	211	211	211	211	211	561	561	561	561	561	561	7,066
	Total	289	221	157	135	135	179	628	3,056	2,908	2,030	2,169	2,427	2,511	2,479	2,288	2,446	2,671	2,689	1,694	1,491	1,260	1,236	1,117	964	37,19
Eagle (70)	Highway Traffic	64	42	20	13	13	29	101	798	752	531	562	659	728	701	668	719	791	794	355	289	227	218	181	132	9,387
	Parking	0	0	0	0	0	0	0	139	134	44	62	44	35	57	18	18	20	20	20	20	0	0	0	0	628
	Residential Fuels	42	42	42	42	42	42	143	143	143	143	143	143	96	96	96	96	96	96	255	255	255	255	255	255	3,218
	Total	106	84	62	55	55	71	244	1,080	1,029	718	767	846	859	854	782	833	907	910	630	564	482	473	436	387	13,233
Kuna (80)	Highway Traffic	9	7	2	2	2	4	15	123	117	82	86	101	110	108	101	110	121	121	53	42	33	33	26	20	1,43
	Parking	0	0	0	0	0	0	0	57	55	18	26	18	16	24	7	9	9	9	9	9	0	0	0	0	26
	Residential Fuels	20	20	20	20	20	20	66	66	66	66	66	66	44	44	44	44	44	44	118	118	118	118	118	118	1,491
	Total	29	27	22	22	22	24	81	246	238	166	178	185	170	176	152	163	174	174	180	169	151	151	144	138	3,184
Rural Ada County (90)	Highway Traffic	611	406	203	134	134	269	996	8,157	7,668	5,337	5,633	6,632	7,284	7,035	6,702	7,229	7,945	7,965	3,470	2,820	2,216	2,127	1,755	1,292	94,016
	Parking	0	0	0	0	0	0	0	335	324	104	150	106	84	137	44	44	46	46	49	49	0	0	0	0	1,519
	Residential Fuels	106	106	106	106	106	106	357	357	357	357	357	357	240	240	240	240	240	240	639	639	639	639	639	639	8,053
	Total	717	512	309	240	240	375	1,353	8,849	8,349	5,798	6,140	7,095	7,608	7,412	6,986	7,513	8,231	8,251	4,158	3,508	2,855	2,766	2,394	1,931	103,588
Northern Ada County Total	Highway Traffic	4,689	3,027	1,515	1,036	1,221	2,542	8,034	50,473	47,629	34,374	36,180	42,417	46,936	45,115	43,136	46,632	52,183	52,704	24,754	20,022	16,125	15,615	12,767	9,281	618,405
	Parking	139	55	22	24	15	46	128	7,564	7,690	3,190	4,839	4,378	4,363	5,580	3,629	3,675	4,859	4,409	2,608	2,597	1,490	586	428	287	62,607
	Residential Fuels	2,036	2,036	2,036	2,036	2,036	2,036	6,854	6,854	6,854	6,854	6,854	6,854	4,612	4,612	4,612	4,612	4,612	4,612	12,262	12,262	12,262	12,262	12,262	12,262	154,583
	Total	6,864	5,118	3,573	3,096	3,272	4,624	15,016	64,891	62,173	44,418	47,873	53,649	55,911	55,307	51,377	54,919	61,654	61,725	39,624	34,881	29,877	28,463	25,457	21,830	835,593

Notes:

Emission forecasting procedures are discussed in Appendix A.

Results may not add to subtotals or totals due to rounding.

Table F-2. Hourly Carbon Monoxide Emissions Summary for 1980

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds)																								Average Winter Daily Emissions (Pounds)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Southeast Area (10)	Highway Traffic	355	225	112	75	75	150	542	3,294	3,128	2,463	2,608	3,036	3,355	3,210	3,027	3,263	3,536	3,600	1,812	1,479	1,208	1,193	972	697	43,410
	Parking	42	26	0	0	0	4	20	747	725	284	489	423	417	586	412	448	591	571	399	461	322	185	249	214	7,621
	Residential Fuels	228	228	228	228	228	228	767	767	767	767	767	767	516	516	516	516	516	516	1,371	1,371	1,371	1,371	1,371	1,371	17,290
	Total	625	479	340	303	303	362	1,329	4,808	4,620	3,514	3,864	4,226	4,288	4,312	3,955	4,227	4,643	4,687	3,582	3,311	2,901	2,749	2,592	2,282	68,329
Northwest Area (21)	Highway Traffic	148	99	49	33	33	66	240	1,980	1,830	1,325	1,393	1,634	1,788	1,720	1,631	1,777	1,905	1,931	847	694	549	531	443	328	22,957
	Parking	0	0	0	0	0	0	0	324	333	150	254	229	216	258	176	176	174	178	172	165	90	9	0	0	2,904
	Residential Fuels	103	103	103	103	103	103	345	345	345	345	345	345	232	232	232	232	232	232	618	618	618	618	618	618	7,788
	Total	251	202	152	136	136	169	585	2,649	2,508	1,820	1,992	2,208	2,236	2,210	2,039	2,185	2,311	2,341	1,637	1,477	1,257	1,158	1,061	946	33,668
CBD Subarea (22)	Highway Traffic	802	494	247	165	165	331	1,193	6,034	5,805	4,822	5,128	5,959	6,662	6,347	5,950	6,407	7,066	7,240	3,869	3,150	2,619	2,610	2,105	1,484	86,653
	Parking	22	2	2	2	2	4	31	414	547	410	586	668	798	888	798	796	1,146	895	445	452	437	179	29	18	9,568
	Residential Fuels	89	89	89	89	89	89	299	299	299	299	299	299	201	201	201	201	201	201	534	534	534	534	534	534	6,734
	Total	913	585	338	256	256	424	1,523	6,747	6,651	5,531	6,013	6,926	7,661	7,436	6,949	7,404	8,413	8,336	4,848	4,136	3,590	3,323	2,668	2,036	102,955
Warm Springs Subarea (23)	Highway Traffic	79	51	26	18	18	36	123	862	814	617	653	761	838	802	758	820	875	888	425	348	280	273	225	163	10,754
	Parking	0	0	0	0	0	0	0	207	201	62	101	77	66	97	46	46	104	97	37	37	0	0	0	0	1,182
	Residential Fuels	60	60	60	60	60	60	204	204	204	204	204	204	137	137	137	137	137	137	364	364	364	364	364	364	4,594
	Total	139	111	86	78	78	96	327	1,273	1,219	883	958	1,042	1,041	1,036	941	1,003	1,116	1,122	826	749	644	637	589	527	16,530
Foothills Subarea (24)	Highway Traffic	64	40	20	13	13	26	99	672	635	483	509	595	657	628	595	642	686	694	335	273	220	216	179	130	8,420
	Parking	0	0	0	0	0	0	0	414	399	126	203	152	126	187	82	84	168	161	77	82	0	0	0	0	2,262
	Residential Fuels	114	114	114	114	114	114	384	384	384	384	384	384	258	258	258	258	258	258	687	687	687	687	687	687	8,660
	Total	178	154	134	127	127	140	483	1,470	1,418	993	1,096	1,131	1,041	1,073	935	984	1,112	1,113	1,099	1,042	907	903	866	817	19,350
Northend Subarea (25)	Highway Traffic	359	229	115	77	77	152	553	3,547	3,362	2,606	2,754	3,210	3,549	3,397	3,210	3,463	3,735	3,803	1,865	1,523	1,239	1,217	996	719	45,753
	Parking	0	0	0	0	0	0	4	891	869	298	474	375	333	467	225	225	282	265	209	216	35	15	4	2	5,190
	Residential Fuels	288	288	288	288	288	288	970	970	970	970	970	970	652	652	652	652	652	652	1,734	1,734	1,734	1,734	1,734	1,734	21,866
	Total	647	517	403	365	365	440	1,527	5,408	5,201	3,874	4,198	4,555	4,534	4,516	4,087	4,340	4,669	4,720	3,808	3,473	3,008	2,966	2,734	2,455	72,809
West Bench Area (30)	Highway Traffic	1,069	692	344	238	273	564	1,801	11,576	10,842	8,111	8,503	9,936	10,953	10,481	9,963	10,836	11,751	11,927	5,646	4,601	3,721	3,629	2,989	2,191	142,637
	Parking	2	0	0	0	0	2	18	1,477	1,517	697	1,184	1,144	1,182	1,391	1,030	1,047	1,215	1,109	765	767	465	148	77	42	15,285
	Residential Fuels	420	420	420	420	420	420	1,413	1,413	1,413	1,413	1,413	1,413	951	951	951	951	951	951	2,528	2,528	2,528	2,528	2,528	2,528	31,872
	Total	1,491	1,112	764	658	693	984	3,232	14,466	13,772	10,221	11,100	12,493	13,086	12,823	11,944	12,834	13,917	13,987	8,939	7,896	6,714	6,305	5,594	4,671	189,794
Central Bench Area (40)	Highway Traffic	1,019	653	326	234	326	699	1,900	9,795	9,136	6,865	7,117	8,289	9,158	8,730	8,391	9,176	10,185	10,373	5,086	4,125	3,389	3,300	2,716	1,997	122,987
	Parking	49	11	11	11	11	18	26	1,777	1,828	774	1,294	1,204	1,202	1,459	990	1,003	1,208	1,091	769	750	366	139	108	49	16,149
	Residential Fuels	522	522	522	522	522	522	1,759	1,759	1,759	1,759	1,759	1,759	1,183	1,183	1,183	1,183	1,183	1,183	3,146	3,146	3,146	3,146	3,146	3,146	39,662
	Total	1,590	1,186	859	767	859	1,239	3,685	13,331	12,723	9,398	10,170	11,252	11,543	11,372	10,564	11,362	12,576	12,647	9,001	8,021	6,901	6,585	5,970	5,192	178,798

Table F-2 (cont'd.)

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Average Winter Daily Emissions (Pounds)
Southwest Area (50)	Highway Traffic	545	359	181	130	190	412	1,082	6,499	6,003	6,865	4,425	5,176	5,675	5,423	5,238	5,752	6,292	6,367	2,906	2,359	1,903	1,825	1,523	1,146	75,707
	Parking	18	16	11	13	7	20	31	538	545	238	386	359	346	412	293	300	445	454	229	231	141	68	37	29	5,172
	Residential Fuels	143	143	143	143	143	143	483	483	483	483	483	483	325	325	325	325	325	325	864	864	864	864	864	864	10,890
	Total	706	518	335	286	340	575	1,596	7,520	7,031	7,586	5,294	6,018	6,346	6,160	5,856	6,377	7,062	7,146	3,999	3,454	2,908	2,757	2,424	2,039	91,769
Boise Metropolitan Area Subtotal	Highway Traffic	4,440	2,842	1,420	983	1,107	2,436	7,533	44,259	41,555	34,157	33,090	38,596	42,635	40,738	38,763	42,136	46,031	46,823	22,791	18,552	15,128	14,794	12,148	8,855	559,314
	Parking	110	55	24	26	20	49	130	6,790	6,962	3,038	4,971	4,632	4,685	5,747	4,052	4,125	5,333	4,822	3,104	3,161	1,856	595	505	353	65,333
	Residential Fuels	1,967	1,967	1,967	1,967	1,967	1,967	6,622	6,622	6,622	6,622	6,622	6,622	4,456	4,456	4,456	4,456	4,456	4,456	11,847	11,847	11,847	11,847	11,847	11,847	149,355
	Total	6,517	4,864	3,411	2,976	3,094	4,452	14,285	57,671	55,139	43,817	44,683	49,850	51,776	50,941	47,271	50,717	55,820	56,101	37,742	33,560	28,831	27,236	24,500	21,055	774,002
Meridian (60)	Highway Traffic	218	143	73	49	49	98	351	2,703	2,531	1,870	1,969	2,304	2,524	2,425	2,297	2,487	2,639	2,661	1,224	1,001	796	774	642	472	32,296
	Parking	0	0	0	0	0	0	0	335	322	104	168	123	101	150	60	62	64	66	68	71	0	0	0	0	1,693
	Residential Fuels	108	108	108	108	108	108	362	362	362	362	362	362	244	244	244	244	244	244	648	648	648	648	648	648	8,174
	Total	326	251	181	157	157	206	713	3,400	3,215	2,336	2,499	2,781	2,869	2,819	2,601	2,793	2,947	2,971	1,940	1,720	1,444	1,422	1,290	1,120	42,163
Eagle (70)	Highway Traffic	73	46	24	15	15	30	115	891	838	617	650	761	836	802	761	822	875	884	403	331	262	256	212	157	10,677
	Parking	0	0	0	0	0	0	0	157	150	49	77	57	46	71	26	28	28	30	30	33	0	0	0	0	785
	Residential Fuels	51	51	51	51	51	51	172	172	172	172	172	172	116	116	116	116	116	116	307	307	307	307	307	307	3,876
	Total	124	97	75	66	66	81	281	1,220	1,160	838	899	990	998	989	903	966	1,019	1,030	740	671	569	563	519	464	15,338
Kuna (80)	Highway Traffic	11	7	4	2	2	4	18	148	139	101	106	123	137	130	123	134	141	141	64	53	42	40	33	24	1,731
	Parking	0	0	0	0	0	0	0	66	64	20	33	24	20	29	11	11	13	13	13	13	0	0	0	0	328
	Residential Fuels	24	24	24	24	24	24	81	81	81	81	81	81	55	55	55	55	55	55	146	146	146	146	146	146	1,835
	Total	35	31	31	26	26	28	99	295	284	202	220	228	212	214	189	200	209	209	223	212	188	186	179	170	3,894
Rural Ada County (90)	Highway Traffic	683	452	227	150	150	302	1,107	9,065	8,481	6,177	6,490	7,608	8,322	8,001	7,588	8,228	8,669	8,733	3,922	3,212	2,540	2,458	2,046	1,515	106,128
	Parking	0	0	0	0	0	0	0	344	331	106	172	126	101	154	60	62	64	66	68	71	0	0	0	0	1,731
	Residential Fuels	119	119	119	119	119	119	400	400	400	400	400	400	269	269	269	269	269	269	715	715	715	715	715	715	9,019
	Total	802	571	346	269	269	421	1,507	9,809	9,212	6,683	7,062	8,134	8,692	8,424	7,917	8,559	9,002	9,068	4,705	3,998	3,255	3,173	2,761	2,230	116,878
Northern Ada County Total	Highway Traffic	5,426	3,492	1,746	1,197	1,387	2,868	9,125	57,069	24,287	40,351	42,305	49,395	54,452	52,097	49,536	53,802	58,354	59,240	28,409	23,151	18,766	18,327	15,082	11,023	710,142
	Parking	134	57	24	26	20	49	130	7,692	7,833	3,318	5,421	4,963	4,956	6,151	4,213	4,290	5,505	4,998	3,287	3,351	1,856	741	505	353	69,869
	Residential Fuels	2,268	2,268	2,268	2,268	2,268	2,268	7,638	7,638	7,638	7,638	7,638	7,638	5,139	5,139	5,139	5,139	5,139	5,139	13,664	13,664	13,664	13,664	13,664	13,664	172,259
	Total	7,828	5,817	4,038	3,491	3,675	5,185	16,893	72,399	39,758	51,307	55,364	61,996	64,547	63,387	58,888	63,231	68,998	69,377	45,360	40,166	34,286	32,732	29,251	25,040	952,270

NOTES:

Emission forecasting procedures are discussed in Appendix B.

Results may not add to subtotals or totals due to rounding.

Table F-3. Hourly Carbon Monoxide Emissions Summary for 1987

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds)																								Average Winter Daily Emissions (Pounds)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Southeast Area (10)	Highway Traffic	293	187	93	62	62	123	450	2,908	2,740	2,317	2,454	2,873	3,183	3,049	2,877	3,109	3,148	3,208	1,559	1,270	1,032	1,016	831	600	39,438
	Parking	18	11	0	0	0	2	18	631	619	245	441	384	373	498	337	362	454	445	342	386	214	126	143	126	6,177
	Residential Fuels	403	403	403	403	403	403	1,356	1,356	1,356	1,356	1,356	1,356	912	912	912	912	912	912	2,426	2,426	2,426	2,426	2,426	2,426	30,583
	Total	714	601	496	465	465	526	1,824	4,895	4,715	3,918	4,251	4,613	4,468	4,459	4,126	4,383	4,514	4,565	4,327	4,082	3,672	3,568	3,400	3,152	76,198
Northwest Area (21)	Highway Traffic	117	77	40	26	26	53	190	1,559	1,457	1,173	1,235	1,448	1,590	1,528	1,448	1,574	1,521	1,537	697	571	452	439	364	269	19,385
	Parking	0	0	0	0	0	0	0	280	284	126	240	223	216	254	181	181	174	163	159	157	73	7	0	0	2,716
	Residential Fuels	191	191	191	191	191	191	644	644	644	644	644	644	433	433	433	433	433	433	1,152	1,152	1,152	1,152	1,152	1,152	14,519
	Total	308	268	231	217	217	244	834	2,483	2,385	1,943	2,119	2,315	2,239	2,215	2,062	2,188	2,128	2,133	2,008	1,880	1,677	1,598	1,516	1,421	36,620
CBD Subarea (22)	Highway Traffic	553	340	170	115	115	227	822	4,090	3,944	3,552	3,779	4,387	4,919	4,685	4,396	4,736	5,004	5,132	2,701	2,196	1,825	1,819	1,466	1,032	62,003
	Parking	11	0	0	0	0	2	18	251	370	322	507	591	745	800	787	778	937	736	536	540	578	152	22	13	8,691
	Residential Fuels	110	110	110	110	110	110	370	370	370	370	370	370	249	249	249	249	249	249	662	662	662	662	662	662	8,346
	Total	674	450	280	225	225	337	1,210	4,711	4,684	4,244	4,656	5,348	5,913	5,739	5,432	5,763	6,190	6,117	3,899	3,398	3,065	2,633	2,150	1,707	79,040
Warm Springs Subarea (23)	Highway Traffic	53	35	18	11	11	22	84	615	573	470	496	580	642	613	580	631	635	642	298	243	196	192	157	115	7,906
	Parking	0	0	0	0	0	0	0	117	115	35	66	57	53	68	40	42	115	104	29	31	0	0	0	0	671
	Residential Fuels	70	70	70	70	70	70	70	236	236	236	236	236	159	159	159	159	159	159	422	422	422	422	422	422	5,315
	Total	123	105	88	81	81	92	154	968	924	741	798	873	854	840	779	832	909	905	749	696	618	614	579	537	14,092
Foothills Subarea (24)	Highway Traffic	64	42	20	13	13	29	101	732	690	573	604	708	776	745	705	763	747	758	362	295	238	231	192	139	9,548
	Parking	0	0	0	0	0	0	0	260	251	79	150	117	101	139	71	73	115	110	73	75	4	0	0	0	1,620
	Residential Fuels	163	163	163	163	163	163	549	549	549	549	549	549	370	370	370	370	370	370	983	983	983	983	983	983	12,391
	Total	227	205	183	176	176	192	650	1,541	1,490	1,201	1,303	1,374	1,247	1,254	1,146	1,206	1,232	1,238	1,418	1,353	1,225	1,214	1,175	1,122	23,559
Northend Subarea (25)	Highway Traffic	205	130	64	44	44	86	313	1,914	1,810	1,559	1,651	1,929	2,136	2,041	1,927	2,077	2,121	2,156	1,071	875	714	705	575	412	26,561
	Parking	0	0	0	0	0	0	2	432	421	146	265	216	194	260	139	141	170	161	137	141	20	9	2	0	2,853
	Residential Fuels	295	295	295	295	295	295	994	994	994	994	994	994	669	669	669	669	669	669	1,778	1,778	1,778	1,778	1,778	1,778	22,415
	Total	500	425	359	339	339	381	1,309	3,340	3,225	2,699	2,910	3,139	2,999	2,970	2,735	2,887	2,960	2,986	2,986	2,794	2,512	2,492	2,355	2,190	51,829
West Bench Area (30)	Highway Traffic	683	441	220	150	168	342	1,124	7,333	6,861	5,670	5,961	6,986	7,721	7,394	7,020	7,619	7,692	7,813	3,702	3,018	2,441	2,388	1,962	1,433	96,139
	Parking	2	0	0	0	0	2	9	811	842	392	734	723	752	864	675	683	844	772	511	518	300	86	44	24	9,592
	Residential Fuels	493	493	493	493	493	493	1,659	1,659	1,659	1,659	1,659	1,659	1,116	1,116	1,116	1,116	1,116	1,116	2,967	2,967	2,967	2,967	2,967	2,967	37,407
	Total	1,178	934	713	643	661	837	2,792	9,803	9,362	7,721	8,354	9,368	9,589	9,374	8,811	9,418	9,652	9,701	7,180	6,503	5,708	5,441	4,973	4,424	143,138
Central Bench Area (40)	Highway Traffic	703	448	225	157	196	414	1,226	6,746	6,301	5,245	5,490	6,415	7,121	6,801	6,479	7,057	7,306	7,445	3,622	2,941	2,407	2,357	1,933	1,409	90,442
	Parking	24	7	7	7	7	9	13	862	888	381	705	668	672	798	564	573	670	604	456	454	201	75	57	24	8,728
	Residential Fuels	555	555	555	555	555	555	1,870	1,870	1,870	1,870	1,870	1,870	1,258	1,258	1,258	1,258	1,258	1,258	3,345	3,345	3,345	3,345	3,345	3,345	42,170
	Total	1,282	1,010	787	719	758	978	3,109	9,478	9,059	7,496	8,065	8,953	9,051	8,857	8,301	8,888	9,234	9,307	7,423	6,740	5,953	5,777	5,335	4,778	141,340

Table F-3 (cont'd.)

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds)																								Average Winter Daily Emissions (Pounds)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Southwest Area (50)	Highway Traffic	386	256	128	90	119	256	723	4,764	4,414	3,499	3,638	4,264	4,687	4,491	4,306	4,711	4,691	4,742	2,163	1,761	1,413	1,362	1,135	849	58,848
	Parking	13	13	9	11	4	15	24	335	346	163	291	282	276	313	243	247	353	362	194	196	121	53	26	22	3,909
	Residential Fuels	185	185	185	185	185	185	623	623	623	623	623	623	419	419	419	419	419	419	419	1,114	1,114	1,114	1,114	1,114	14,042
	Total	584	454	322	286	308	456	1,370	5,722	5,383	4,285	4,552	5,169	5,382	5,223	4,968	5,377	5,463	5,523	3,471	3,071	2,648	2,529	2,275	1,985	76,799
Boise Metropolitan Area Subtotal	Highway Traffic	3,058	1,956	977	668	754	1.552	5,033	30,660	28,790	24.057	25,307	29,590	32,774	31,348	29,738	32,276	32,867	33,433	16,173	13,170	10,719	10,509	8,616	6,257	410,271
	Parking	68	31	15	18	11	31	84	3,979	4,138	1,889	3,400	3,261	3,382	3,995	3,036	3,080	3,832	3,457	2,436	2,498	1,510	507	295	209	45,157
	Residential Fuels	2,465	2,465	2,465	2,465	2,465	2,465	8,300	8,300	8,300	8,300	8,300	8,300	5,585	5,585	5,585	5,585	5,585	5,585	14,849	14,849	14,849	14,849	14,849	14,849	187,191
	Total	5,591	4,452	3,457	3,151	3,230	4,048	13,417	42,939	41,228	34,246	37,007	41,151	41,741	40,928	38,359	40,941	42,284	42,475	33,458	30,517	27,078	25,865	23,760	21,315	642,619
Meridian (60)	Highway Traffic	108	71	35	24	24	46	172	1,318	1,237	1.016	1,069	1,254	1,376	1,321	1,252	1,354	1,318	1,332	622	509	406	395	326	240	16,830
	Parking	0	0	0	0	0	0	0	231	223	71	132	101	86	119	55	57	59	62	64	66	0	0	0	0	1,334
	Residential Fuels	161	161	161	161	161	161	543	543	543	543	543	543	366	366	366	366	366	366	972	972	972	972	972	972	12,255
	Total	269	238	196	185	185	207	715	2,092	2,003	1,630	1,744	1,898	1,828	1,806	1,673	1,777	1,743	1,760	1,658	1,547	1,378	1,367	1,298	1,212	30,419
Eagle (70)	Highway Traffic	62	40	20	13	13	26	97	798	743	600	631	741	814	780	739	802	785	794	359	293	234	227	187	139	9,941
	Parking	0	0	0	0	0	0	0	110	106	33	64	49	40	57	26	26	28	28	31	31	0	0	0	0	633
	Residential Fuels	77	77	77	77	77	77	258	258	258	258	258	258	173	173	173	173	173	173	461	461	461	461	461	461	5,813
	Total	139	117	97	90	90	103	355	1,166	1,107	891	953	1,048	1,027	1,010	938	1,001	986	995	851	785	695	688	648	600	16,387
Kuna (80)	Highway Traffic	9	7	2	2	2	4	13	112	106	86	90	106	115	113	106	115	110	110	51	42	33	31	26	20	1,405
	Parking	0	0	0	0	0	0	0	53	51	18	31	24	20	29	13	13	13	15	15	15	0	0	0	0	309
	Residential Fuels	41	41	41	41	41	41	137	137	137	137	137	137	92	92	92	92	92	92	245	245	245	245	245	245	3,094
	Total	50	48	43	43	43	45	150	302	294	241	258	267	227	234	211	220	215	217	311	302	278	276	271	265	4,812
Rural Ada County (90)	Highway Traffic	439	291	143	97	97	194	708	5,807	5,441	4,405	4,634	5,434	5,952	5,725	5,432	5,882	5,653	5,695	2,604	2,134	1,691	1,638	1,360	1,010	72,464
	Parking	0	0	0	0	0	0	0	205	198	64	119	90	77	106	51	51	53	55	57	60	0	0	0	0	1,186
	Residential Fuels	152	152	152	152	152	152	511	511	511	511	511	511	344	344	344	344	344	344	914	914	914	914	914	914	11,527
	Total	591	443	295	249	249	346	1,219	6,523	6,150	4,980	5,264	6,035	6,373	6,175	5,827	6,277	6,050	6,094	3,575	3,108	2,605	2,552	2,274	1,924	85,177
Northern Ada County Total	Highway Traffic	3,677	2,361	1,179	802	891	1,823	6,023	38,696	36,315	30,166	31,731	37,121	41,030	39,286	37,265	40,428	40,735	41,363	19,806	16,147	13,080	12,798	10,518	7,670	510,915
	Parking	68	31	15	17	11	31	82	4,579	4,716	2,079	3,748	3,523	3,602	4,306	3,183	3,228	3,986	3,618	2,604	2,672	1,508	505	293	209	48,616
	Residential Fuels	2,895	2,895	2,895	2,895	2,895	2,895	9,749	9,749	9,749	9,749	9,749	9,749	6,560	6,560	6,560	6,560	6,560	6,560	17,441	17,441	17,441	17,441	17,441	17,441	219,877
	Total	6,640	5,289	4,089	3,714	3,797	4,749	15,854	53,024	50,780	41,994	45,228	50,393	51,192	50,152	47,008	50,216	51,281	51,541	39,851	36,260	32,029	30,744	28,252	25,320	779,408

NOTES:

Emission forecasting procedures are discussed in Appendix A.

Results may not add to subtotals or totals due to rounding.

Table F-4. Hourly Carbon Monoxide Emissions Summary for 2000

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds)																								Average Winter Daily Emission (Pounds)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Southeast Area (10)	Highway Traffic	231	148	73	49	49	99	357	2,811	2,597	2,222	2,388	2,930	3,408	3,234	3,027	3,386	3,362	3,289	1,365	1,076	858	836	681	492	38,965
	Parking	9	4	0	0	0	2	11	478	474	187	346	304	293	381	256	269	335	328	245	271	128	75	75	66	4,539
	Residential Fuels	702	702	702	702	702	702	2,364	2,364	2,364	2,364	2,364	2,364	1,590	1,590	1,590	1,590	1,590	1,590	4,229	4,229	4,229	4,229	4,229	4,229	53,308
	Total	942	854	775	751	751	803	2,732	5,653	5,435	4,773	5,098	5,598	5,291	5,205	4,873	5,245	5,287	5,207	5,839	5,576	5,215	5,140	4,985	4,787	96,812
Northwest Area (21)	Highway Traffic	79	53	26	18	18	35	128	1,160	1,060	917	972	1,157	1,292	1,243	1,182	1,287	1,190	1,195	496	401	317	306	254	187	14,974
	Parking	0	0	0	0	0	0	0	207	207	84	165	148	144	174	117	117	115	106	104	104	37	2	0	0	1,832
	Residential Fuels	336	336	336	336	336	336	1,133	1,133	1,133	1,133	1,133	1,133	762	762	762	762	762	762	2,027	2,027	2,027	2,027	2,027	2,027	25,551
	Total	415	389	362	354	354	371	1,261	2,500	2,400	2,134	2,270	2,438	2,198	2,179	2,061	2,166	2,067	2,063	2,627	2,532	2,381	2,335	2,281	2,214	42,357
CBD Area (22)	Highway Traffic	414	254	128	84	84	170	617	3,459	3,331	3,073	3,327	4,041	4,740	4,480	4,211	4,616	4,784	4,855	2,176	1,713	1,404	1,391	1,116	783	55,254
	Parking	4	0	0	0	0	0	9	146	205	170	273	320	406	441	423	417	518	401	273	280	284	77	13	9	4,672
	Residential Fuels	159	159	159	159	159	159	535	535	535	535	535	535	360	360	360	360	360	360	957	957	957	957	957	957	12,062
	Total	577	413	287	243	243	329	1,161	4,140	4,071	3,778	4,135	4,896	5,506	5,281	4,994	5,393	5,662	5,616	3,406	2,950	2,645	2,425	2,086	1,749	71,988
Warm Springs Subarea (23)	Highway Traffic	42	26	13	9	9	18	66	606	547	437	476	582	686	648	611	679	688	705	258	201	159	154	128	93	7,842
	Parking	0	0	0	0	0	0	0	60	60	18	35	31	29	37	22	22	55	51	15	17	0	0	0	0	452
	Residential Fuels	90	90	90	90	90	90	303	303	303	303	303	303	204	204	204	204	204	204	541	541	541	541	541	541	6,825
	Total	132	116	103	99	99	108	369	969	910	758	814	916	919	889	837	905	947	960	814	759	700	695	669	634	15,119
Foothills Subarea (24)	Highway Traffic	57	37	20	13	13	24	90	712	668	595	631	743	827	794	754	818	750	754	340	278	223	216	179	130	9,658
	Parking	0	0	0	0	0	0	0	93	91	29	55	46	40	55	31	31	51	49	29	29	2	0	0	0	631
	Residential Fuels	254	254	254	254	254	254	855	855	855	855	855	855	575	575	575	575	575	575	1,530	1,530	1,530	1,530	1,530	1,530	19,285
	Total	311	291	274	267	267	278	945	1,660	1,614	1,479	1,541	1,644	1,442	1,424	1,360	1,424	1,376	1,378	1,899	1,837	1,755	1,746	1,709	1,660	29,574
Northend Subarea (25)	Highway Traffic	146	93	46	31	31	62	223	1,440	1,356	1,232	1,327	1,614	1,892	1,795	1,676	1,830	1,863	1,889	818	642	518	511	412	293	21,740
	Parking	0	0	0	0	0	0	0	201	199	68	128	106	97	128	71	71	84	79	68	70	9	4	0	0	1,385
	Residential Fuels	304	304	304	304	304	304	1,023	1,023	1,023	1,023	1,023	1,023	688	688	688	688	688	688	1,830	1,830	1,830	1,830	1,830	1,830	23,067
	Total	450	397	350	335	335	366	1,246	2,664	2,578	2,323	2,478	2,743	2,677	2,611	2,435	2,589	2,635	2,656	2,716	2,542	2,357	2,345	2,242	2,123	46,192
West Bench Area (30)	Highway Traffic	494	317	159	110	143	309	1,065	6,338	5,633	4,634	4,857	5,858	6,673	6,347	6,155	7,002	7,247	7,304	2,983	2,271	1,814	1,750	1,433	1,047	81,944
	Parking	0	0	0	0	0	0	4	470	487	223	428	423	441	507	399	403	551	503	291	293	163	42	20	11	5,661
	Residential Fuels	618	618	618	618	618	618	2,081	2,081	2,081	2,081	2,081	2,081	1,400	1,400	1,400	1,400	1,400	1,400	3,722	3,722	3,722	3,722	3,722	3,722	46,921
	Total	1,112	935	777	728	761	927	3,150	8,889	8,201	6,938	7,366	8,362	8,514	8,254	7,954	8,805	9,198	9,207	6,996	6,286	5,699	5,514	5,175	4,780	134,526
Central Bench Area (40)	Highway Traffic	430	276	137	99	148	320	864	4,425	4,034	3,481	3,631	4,317	4,892	4,650	4,497	5,040	5,170	5,232	2,293	1,812	1,482	1,435	1,175	862	60,702
	Parking	11	2	2	2	2	4	7	437	450	190	364	342	344	410	291	293	346	309	234	232	95	35	26	11	4,442
	Residential Fuels	638	638	638	638	638	638	2,147	2,147	2,147	2,147	2,147	2,147	1,445	1,445	1,445	1,445	1,445	1,445	3,841	3,841	3,841	3,841	3,841	3,841	48,425
	Total	1,079	916	777	739	788	962	3,018	7,009	6,631	5,818	6,142	6,806	6,681	6,505	6,233	6,778	6,961	6,986	6,368	5,885	5,418	5,311	5,042	4,714	113,569

Table F-4 (cont'd.)

Community Planning Area (CPA #)	Emissions Component	Average Hourly Emissions (pounds) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Average Winter Daily Emissions (Pounds)
Southwest Area (50)	Highway Traffic	300	198	99	71	99	216	591	4,394	3,951	3,188	3,355	4,160	4,657	4,601	4,383	4,941	4,941	4,899	1,858	1,888	3,118	1,041	902	675	58,246
	Parking	9	7	7	7	2	9	15	243	254	121	225	221	219	247	196	198	271	275	159	159	99	35	18	11	3,016
	Residential Fuels	299	299	299	299	299	299	1,006	1,006	1,006	1,006	1,006	1,006	677	677	677	677	677	677	1,799	1,799	1,799	1,799	1,799	1,799	22,677
	Total	608	504	405	377	400	522	1,612	5,643	5,211	4,315	4,586	5,387	5,553	5,525	5,256	5,816	5,891	5,851	3,812	3,462	3,636	2,875	2,719	2,487	83,939
Boise Metropolitan Area Subtotal	Highway Traffic	2,194	1,402	701	483	593	1,250	4,001	25,344	23,177	19,703	20,964	25,402	29,266	27,791	26,495	29,599	29,096	30,172	12,582	9,837	7,911	7,692	6,279	4,561	347,424
	Parking	33	13	9	9	4	15	46	2,332	2,425	1,089	2,019	1,940	2,011	2,381	1,806	1,821	2,326	2,101	1,418	1,455	818	271	152	110	26,630
	Residential Fuels	3,399	3,399	3,399	3,399	3,399	3,399	11,445	11,445	11,445	11,435	11,443	11,445	7,701	7,701	7,701	7,701	7,701	7,701	20,475	20,475	20,475	20,475	20,475	20,475	258,121
	Total	5,626	4,814	4,109	3,891	3,996	4,664	15,492	39,121	37,047	32,116	34,426	38,787	38,978	37,873	36,002	39,121	40,023	39,924	34,475	31,767	29,205	28,438	26,906	25,146	632,175
Meridian (60)	Highway Traffic	90	60	29	20	20	40	143	1,237	1,135	977	1,043	1,257	1,431	1,369	1,290	1,016	1,356	1,358	556	443	351	340	280	205	16,440
	Parking	0	0	0	0	0	0	0	201	194	62	121	91	79	110	53	55	57	57	60	62	0	0	0	0	1,204
	Residential Fuels	301	301	301	301	301	301	1,013	1,013	1,013	1,013	1,013	1,013	681	681	681	681	681	681	1,812	1,812	1,812	1,812	1,812	1,812	22,840
	Total	391	361	330	321	321	361	1,156	2,451	2,342	2,052	2,177	2,361	2,191	2,160	2,024	1,752	2,094	2,096	2,428	2,317	2,163	2,152	2,092	2,017	40,484
Eagle (70)	Highway Traffic	44	29	15	9	9	20	71	648	584	492	525	637	714	688	650	721	679	679	271	218	172	168	137	101	8,278
	Parking	0	0	0	0	0	0	0	95	91	29	57	44	37	51	24	26	26	26	29	28	0	0	0	0	562
	Residential Fuels	139	139	139	139	139	139	468	468	468	468	468	468	315	315	315	315	315	315	837	837	837	837	837	837	10,555
	Total	183	168	154	148	148	159	539	1,211	1,143	989	1,050	1,149	1,066	1,054	989	1,062	1,020	1,020	1,136	1,083	1,009	1,005	974	938	19,395
Kuna (80)	Highway Traffic	7	4	2	2	2	2	11	95	90	79	84	99	108	106	99	108	95	95	42	35	26	26	22	15	1,257
	Parking	0	0	0	0	0	0	0	51	49	15	31	24	20	26	13	13	13	15	15	15	0	0	0	0	300
	Residential Fuels	84	84	84	84	84	84	281	281	281	281	281	281	189	189	189	189	189	189	503	503	503	503	503	503	6,332
	Total	91	88	86	86	86	86	292	427	420	375	396	404	317	321	301	310	297	299	560	553	529	529	525	518	7,890
Rural Ada County (90)	Highway Traffic	302	201	101	68	68	132	485	4,273	3,975	3,510	3,706	4,387	4,848	4,669	4,442	4,813	4,331	4,321	1,887	1,537	1,210	1,171	970	719	56,092
	Parking	0	0	0	0	0	0	0	128	124	40	77	60	51	71	33	35	35	37	37	40	0	0	0	0	772
	Residential Fuels	210	210	210	210	210	210	706	706	706	706	706	706	475	475	475	475	475	475	1,264	1,264	1,264	1,264	1,264	1,261	19,931
	Total	512	411	311	278	278	342	1,191	5,107	4,805	4,256	4,489	5,153	5,374	5,215	4,950	5,323	4,811	4,833	3,188	2,841	2,474	2,435	2,234	1,983	76,795
Northern Ada County Total	Highway Traffic	2,832	1,693	847	582	690	1,442	4,711	31,594	28,964	24,837	26,121	31,782	36,367	34,621	32,951	36,656	36,429	36,577	15,382	12,070	9,472	9,396	7,680	5,602	439,496
	Parking	33	15	9	9	7	15	46	2,809	2,881	1,241	2,506	2,163	2,198	2,637	1,929	1,971	2,460	2,240	1,561	1,604	822	271	154	110	29,467
	Residential Fuels	4,132	4,132	4,132	4,132	4,132	4,132	13,913	13,913	13,913	13,913	13,913	13,913	9,362	9,362	9,362	9,362	9,362	9,362	24,091	24,091	24,091	24,091	24,091	24,091	313,792
	Total	6,997	5,840	4,988	4,723	4,829	5,589	18,670	48,316	45,758	39,991	42,540	47,858	47,927	46,620	44,242	47,989	48,251	48,179	41,794	38,564	35,385	34,558	31,933	30,603	782,753

NOTES:

Emission forecasting procedures are discussed in Appendix A.

Results may not add to subtotals or tot due to rounding.

Reproduced from best available copy.

Appendix G

SUMMARY OF EXISTING CARBON MONOXIDE MONITORING DATA

Prepared by:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

February 1981

TABLE OF CONTENTS

Page

SUMMARY OF EXISTING CARBON MONOXIDE MONITORING DATA G-1
    Introduction G-1
    ESL/CH2M Hill Study G-1
    EPA Study G-4
    Idaho Air Quality Bureau Study G-7
    Air Quality Bureau Monitoring Station Data G-12
    Idaho Transportation Department Monitoring Data G-21
    Summary G-21

BIBLIOGRAPHY G-23

LIST OF TABLES

Table		Page
G-1	Summary of CO Data Collected During 1974 ESL/CH2M Hill Study	G-3
G-2	Summary of CO Data Collected During the EPA Study	G-6
G-3	Summary of CO Data Collected During the 1977-1978 Idaho Air Quality Bureau Study	G-9
G-4	Summary of CO Data From the Boise Odd Fellows Hall Monitoring Station	G-13
G-5	Summary of CO Data From the Central District Health Department Monitoring Station	G-15

LIST OF FIGURES

Figure		Page
G-1	Monitoring Sites Used in the ESL/CH2M Hill Study	G-2
G-2	Monitoring Sites Used During the EPA Carbon Monoxide Study	G-5
G-3	Monitoring Sites Used During the Idaho Air Quality Bureau CO Study	G-8
G-4	Average Winter CO Levels at the Boise Odd Fellows Hall Monitoring Station	G-16
G-5	Average Winter CO Levels at the Central District Health Department Monitoring Station	G-17
G-6	Time Periods With 8-Hour CO Levels >9.0 ppm at the Boise Odd Fellows Hall Monitoring Station	G-18
G-7	Time Periods With 8-Hour CO Levels >9.0 ppm at Central District Health Department Monitoring Station	G-19

SUMMARY OF EXISTING CARBON MONOXIDE MONITORING DATA

Introduction

Ambient air quality monitoring in the Boise area has focused on carbon monoxide (CO). The Idaho Air Quality Bureau operates two permanent CO monitoring stations which provide continuous monitoring data. The Idaho Transportation Department operates a third continuous monitoring station at its State Street offices. There have also been three special CO monitoring programs which provide additional data on the nature and extent of CO problems. There has been a limited amount of monitoring for other pollutants. Since data are limited for other pollutants, the focus of this appendix will be on CO.

EPA has established two sets of ambient air quality standards for CO. The standard for 1-hour exposures is currently 35 ppm (parts per million), to be exceeded no more than once per year at any air quality monitoring site. An additional standard has been set for 8-hour exposures. This standard (9 ppm averaged over a consecutive 8-hour period) is also to be exceeded no more than once per year. In practice, the 8-hour standard is more stringent than the current 1-hour standard. EPA has proposed changing the 1-hour standard to 25 ppm, but no final action has yet been taken.

ESL/CH2M Hill Study

The first significant air quality monitoring program in the Boise area was conducted from January through May 1974. Monitoring site locations are shown in Figure G-1. In addition to these monitoring stations, short-term bag sampling was conducted at street intersections near four of the five fixed stations. Table G-1 summarizes the CO data collected by continuous monitoring instruments during this study. As can be seen from this table, the federal 8-hour CO standard was exceeded at three of the five sites. At the Eastman Building site, peak CO levels were greatest at the lower of the two sampling positions. None of the short-term bag sampling identified any violation of the federal 1-hour standard.

This study concluded that CO problems existed in the downtown Boise area, and at some more outlying areas. It was also concluded that areas on the first bench or higher locations generally comply with the federal CO standards.

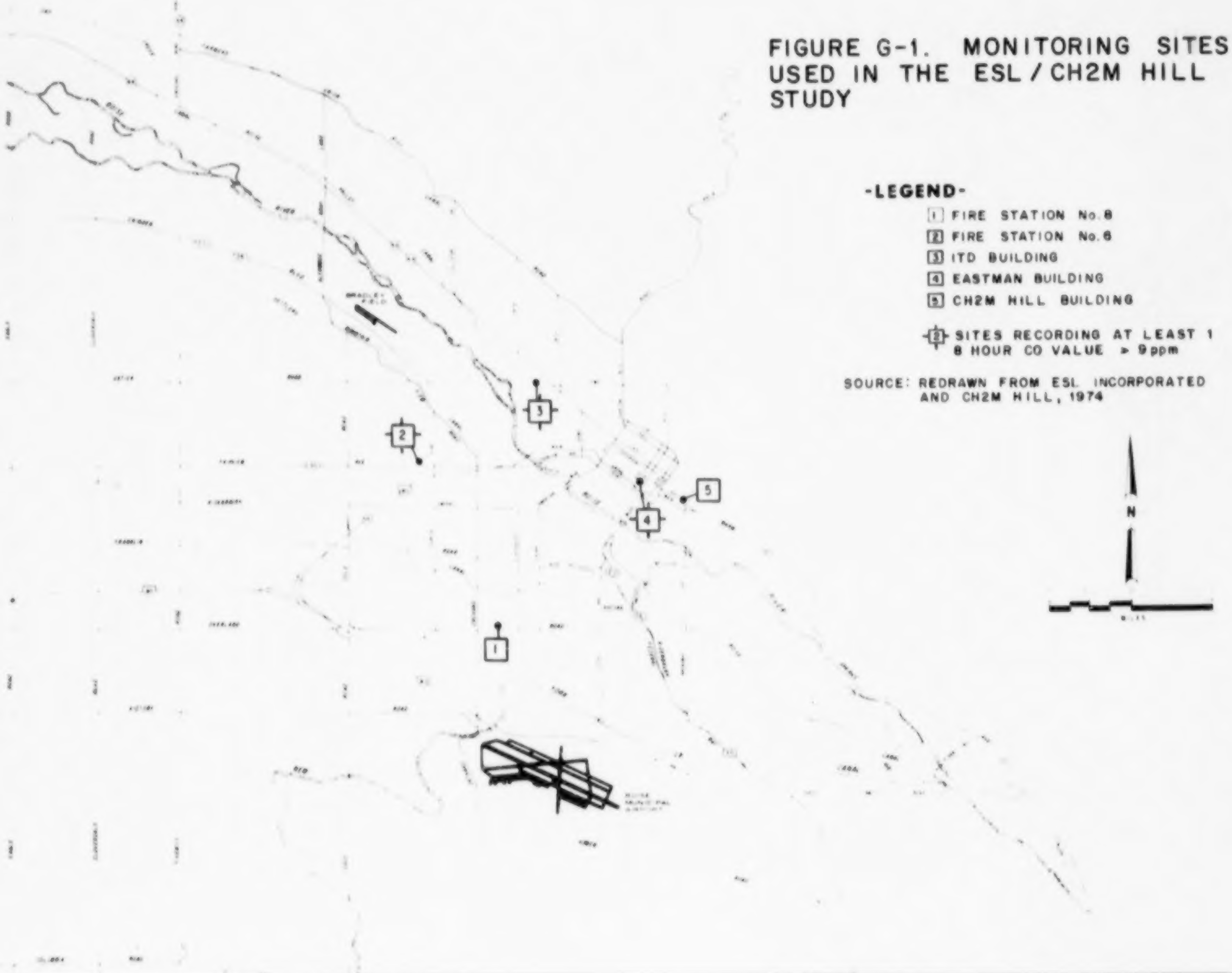

-LEGEND-
1 FIRE STATION No. 8
2 FIRE STATION No. 6
3 ITD BUILDING
4 EASTMAN BUILDING
5 CH2M HILL BUILDING
2 SITES RECORDING AT LEAST 1 8 HOUR CO VALUE > 9 ppm
1
2
3
4
5
N

FIGURE G-1. MONITORING SITES USED IN THE ESL / CH2M HILL STUDY

SOURCE: REDRAWN FROM ESL INCORPORATED AND CH2M HILL, 1974

Table G-1. Summary of CO Data Collected During
1974 ESL/CH2M Hill Study

Monitoring Station	Month	Peak 1-Hour CO (ppm)	Peak 8-Hour CO (ppm)	Days with Peak 8-Hour CO Above 9.0 ppm	Days of Data
Eastman Building, 2nd Floor	January	23.0	14.9	6	10
	February	24.0	16.3	13	25
	March	21.8	12.5	9	31
	April	18.9	12.5	2	9
	May	23.7	19.6	16	20
Eastman Building, 6th Floor	January	20.4	12.3	8	25
	February	21.3	15.5	7	27
CH2M Hill Building	March/April	16.4	6.4	0	33
State Highway Building	March/April	20.3	9.5	1	32
Fire Station No. 6	April/May	10.5	9.3	2	35
Fire Station No. 8	April/May	6.3	2.5	0	40

Notes: Federal 1-hour standard is 35.0 ppm, to be exceeded no more than once per year.
Federal 8-hour standard is 9.0 ppm, to be exceeded no more than once per year.

DATA SOURCE: ESL, Inc., and CH2M Hill, 1974.

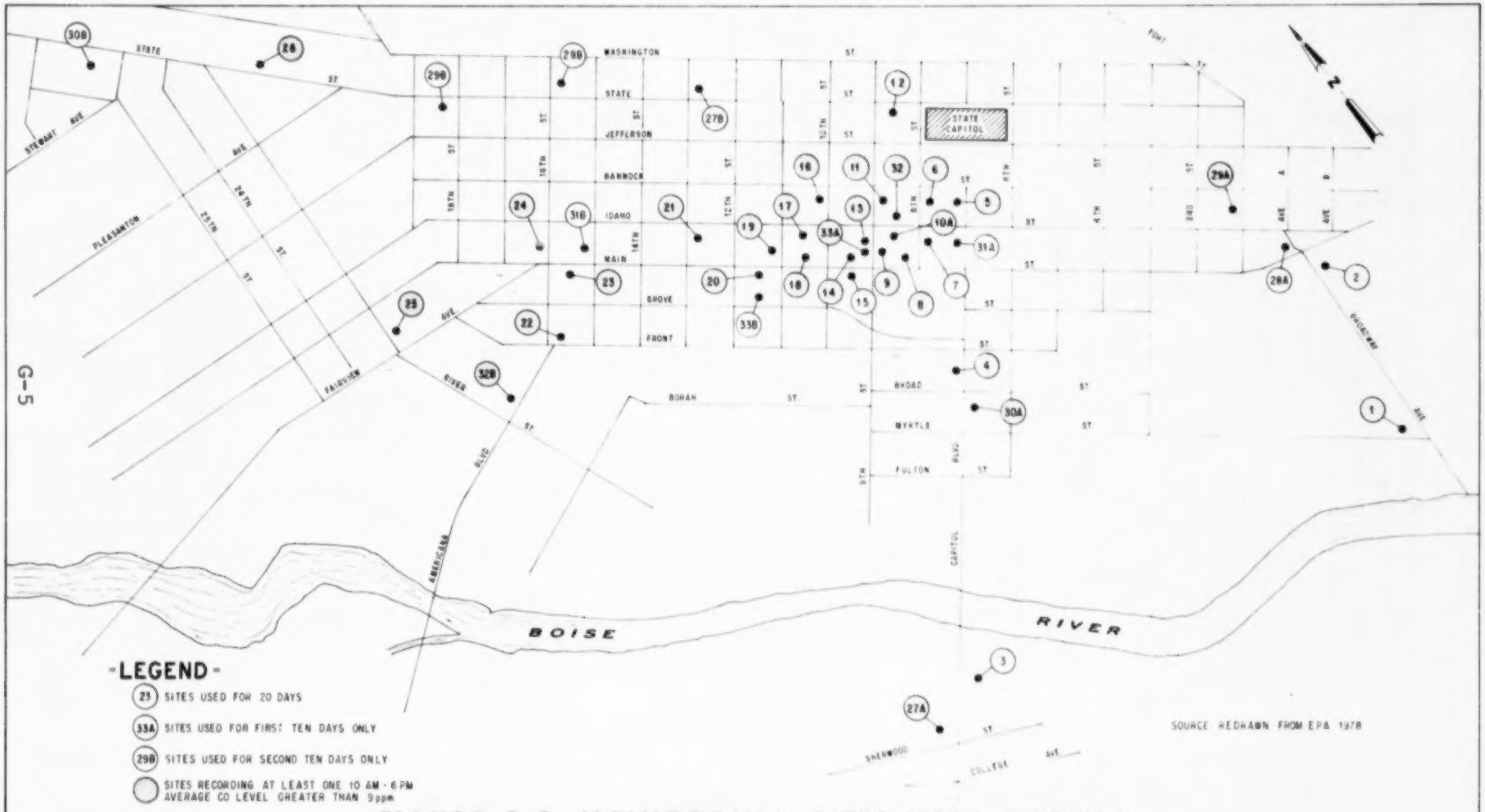
Wind data collected during this study indicated that wind speeds measured at Boise airport were significantly higher than those measured at the air quality monitoring sites. In general, high CO levels occurred under low wind speed conditions. Instruments on top of the six-story Eastman Building recorded two instances during which wind speeds were less than 2 mph for 8 consecutive hours. During the study period, wind speeds of less than 2 mph were recorded during 10.6-42.5 percent of the time at various monitoring sites.

One unexpected result of the ESL/CH2M Hill study involved the seasonality of high CO levels. Carbon monoxide problems are generally most severe and most frequent during the winter months (November through February). The observed frequency of high 8-hour average CO levels during March, April, and May was thus rather unexpected. Data presented in the ESL/CH2M Hill report indicate that May 1974 was characterized by frequent periods of low wind speeds.

EPA Study

The EPA conducted a 20-day study between November 25 and December 22, 1977. The study had four major objectives: 1) to obtain additional data regarding the magnitude of the Boise CO problem, 2) to determine its spatial extent, 3) to determine the representativeness of the permanent CO monitor established in 1975, and 4) to assist in the selection of candidate sites for an additional permanent monitor. This study collected consecutive 4-hour bag samples at 33 sites between 10:00 a.m. and 6:00 p.m. over a period of 20 weekdays. Sampling equipment from seven sites was shifted to new locations during the last 10 days of the study, resulting in 20 days of data from 26 sites and 10 days of data from 14 other sites. In addition, CO data were collected at six indoor sites and along two pedestrian walking routes.

Figure G-2 shows the locations of the 40 outdoor monitoring sites. Monitoring results showed that elevated CO concentrations are not limited to the central business district. High CO levels were also measured along traffic corridors in areas adjacent to the Boise central business district. The peak 8-hour CO level measured during this study was 17.2 ppm at site 32 on December 22, 1977 (the last day of the study). As is indicated in Figure G-2, only four of the twenty-six 4-week monitoring sites failed to record an 8-hour CO value greater than the 9 ppm standard. On the other hand, eight of the fourteen 2-week monitoring sites failed to record any CO levels above the standard. Six of these eight sites were operated only during the last 2 weeks of the study.


N
WASHINGTON
STATE
JEFFERSON
BANNOCK
IDAHO
MAIN
GROVE
FRONT
BORAH ST
BROAD
MYRTLE
FULTON ST
CAPITOL BLVD
STATE CAPITOL
9TH
10TH ST
12TH ST
14TH
16TH ST
18TH ST
8TH
6TH
4TH ST
2ND ST
AVE A
AVE B
FORT ST
BROADWAY AVE
STATE ST
STEWART AVE
PLEASANTON
24TH ST
25TH ST
FAIRVIEW AVE
RIVER ST
AMERICANA BLVD
BOISE RIVER
SHERWOOD ST
COLLEGE AVE
1
2
3
4
5
6
7
8
9
10A
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27A
27B
28A
29A
29B
30A
30B
31A
31B
32
32B
33A
33B
-LEGEND-
23 SITES USED FOR 20 DAYS
33A SITES USED FOR FIRST TEN DAYS ONLY
29B SITES USED FOR SECOND TEN DAYS ONLY
SITES RECORDING AT LEAST ONE 10 AM - 6 PM AVERAGE CO LEVEL GREATER THAN 9ppm

SOURCE REDRAWN FROM EPA 1978

FIGURE G-2. MONITORING SITES USED DURING THE EPA CARBON MONOXIDE STUDY

This study concluded that the state's permanent monitoring station on Ninth Street is generally representative of CO concentrations in downtown Boise, although the station underestimated the magnitude and frequency of elevated CO levels. For example, the permanent station recorded exceedences of the federal 8-hour CO standard on 47 percent of the study days. This is in contrast to one or more of the study sites recording exceedences on 95 percent of the days. The state's downtown monitoring station recorded an 8-hour CO level of 13.7 ppm at the time that EPA's site 32 station recorded the 17.2 ppm average noted above. On 19 of the 20 days in the study at least one of the EPA study sites had a 10:00 a.m. to 6:00 p.m. average CO level greater than the simultaneous reading at the state's Ninth Street monitoring station. Table G-2 summarizes data from this study.

The EPA study confirmed that Boise has a serious CO problem, and that high CO levels occur at more than a few isolated locations. As can be seen in Table G-2, peak CO levels occurred simultaneously at numerous monitoring sites on December 2, 1977. Twenty-four of the 29 monitoring sites operating on December 2 recorded 8-hour CO values above the 9 ppm standard, and only two of these stations reported higher CO levels on any other day of the study.

The EPA study did not, however, fully characterize the spatial extent of Boise's CO problem. Because all but one of the monitoring sites were close to roadways, the study results could not distinguish an "areawide" pattern of high CO concentrations from a "highway corridor vicinity" pattern.

The EPA study included a limited amount of monitoring at six indoor locations (4 retail stores, 1 hotel and 1 hospital). Four of the six indoor sites recorded an 8-hour average CO level greater than 9 ppm. All monitoring locations at these buildings were sited to avoid the influence of tobacco smoke. Monitoring was too limited to provide detailed correlation analysis. In general, however, indoor CO levels were somewhat less than outdoor levels. Fluctuations in CO levels at several indoor sites generally paralleled outdoor CO changes. These results are generally consistent with other studies of indoor vs. outdoor CO levels (California Air Resources Board 1971; Bellin and Spengler 1980), although some studies found no difference between indoor and outdoor CO levels (Yocom et al. 1977).

Idaho Air Quality Bureau Study

In an attempt to better characterize the spatial extent of the carbon monoxide problem in Boise, the Idaho Air Quality Bureau conducted a special monitoring program between November 7, 1977 and March 6, 1978. The major purpose of the study was

Table G-2. Summary of CO Data Collected During the EPA Study

EPA Monitoring Site Number	Number of 8-Hour CO Values Exceeding 9.0 ppm	Days of Data	Highest 10 am-6 pm CO Value (ppm)	Date of Highest CO Value At EPA Site	Simultaneous 8-Hour CO Value (ppm) at Ninth Street Permanent Monitoring Station
1	12	20	14.7	12/02/77	10.5
2	0	20	9.0	11/25/77	8.8
3	0	20	4.8	11/25/77	8.8
4	1	20	9.5	12/02/77	10.5
5	3	20	13.5	12/02/77	10.5
6	2	18	10.5	12/02/77	10.5
7	0	12	8.4	11/30/77	10.7
8	1	12	13.0	11/25/77	8.8
9	6	17	13.6	12/02/77	10.5
10A	5	10	15.9	12/02/77	10.5
11	8	18	15.6	12/02/77	10.5
12	1	17	9.5	12/02/77	10.5
13	10	18	14.2	12/22/77	13.7
14	1	18	11.2	11/25/77	8.8
15	0	15	7.6	12/22/77	13.7
16	2	19	9.9	12/02/77	10.5
17	3	16	15.2	12/02/77	10.5
18	7	19	15.3	12/02/77	10.5
19	5	20	12.1	12/02/77	10.5
20	7	19	13.8	12/02/77	10.5
21	1	20	9.9	12/02/77	10.5
22	2	20	11.1	12/02/77	10.5
23	3	17	13.0	12/01/77	NR
24	2	20	15.1	12/02/77	10.5
25	2	19	13.4	12/02/77	10.5
26	1	20	10.6	12/02/77	10.5
27A	1	10	10.1	12/02/77	10.5
27B	0	10	5.3	12/22/77	13.7
28A	0	9	8.0	12/02/77	10.5
28B	0	9	7.8	12/22/77	13.7
29A	1	10	9.5	12/02/77	10.5
29B	0	10	5.4	12/12/77	5.2
30A	3	10	11.4	12/02/77	10.5
30B	0	10	6.0	12/14/77	4.0
31A	0	8	8.7	11/28/77	9.8
31B	0	8	6.3	12/22/77	13.7
32A	14	20	17.2	12/22/77	13.7
32B	1	7	9.7	12/12/77	5.2
33A	3	6	11.6	11/30/77	10.7
33B	0	10	8.4	12/14/77	4.0

NOTES:

NR = no data reported.

Stations designated with an "A" were operated during the first two weeks of the study. Stations designated with a "B" were operated during the last two weeks of the study.

DATA SOURCE: EPA 1978.

Reproduced from best available copy.

to assess carbon monoxide levels in areas outside the central business district of Boise. The bench areas southwest of the Boise River received special attention. Three portable CO monitors were used to collect data for 1-week time periods at a total of 46 sites. Traffic counts were made at most of the monitoring sites. Wind speed and direction data were collected at a limited number of sites. Monitoring sites were classified by location as either valley or bench sites, and by proximity to major roadways as either traffic corridor or neighborhood sites.

Figure G-3 shows the locations of the 46 monitoring sites. Despite the limited duration of monitoring at any one site, 20 of the 46 sites recorded at least one 8-hour average CO value above the 9 ppm standard. Only one of the 12 neighborhood sites reported an 8-hour CO level above the federal standard, while 19 of 34 traffic corridor stations reported at least one such episode. Overall, 6 of 25 valley sites (all traffic corridor stations) and 14 of 21 bench sites (1 neighborhood and 13 traffic corridor stations) reported 8-hour CO values above the federal standard.

Table G-3 summarizes the monitoring data collecting during this study. The highest 8-hour CO values were monitored at traffic corridor sites on the bench. Eight of ten stations reporting peak 8-hour CO values of 12 ppm or more were bench sites. The highest 8-hour CO value recorded during the study (25.0 ppm) occurred on a day when the permanent downtown monitoring station did not record any violations of the 8-hour standard. This value also exceeded the peak 8-hour CO value recorded by the Ninth Street monitoring station during all of 1978. The only neighborhood site to record an 8-hour CO value above 9 ppm recorded an 11.1 ppm 8-hour average at this time.

The results of the Air Quality Bureau study clearly indicated that high CO levels occurred near major traffic arteries on the bench as well as in valley areas. The results also confirmed the observations of the EPA study regarding the occurrence of high CO levels even when the Ninth Street monitoring station shows no violation of the federal 8-hour standard.

The Air Quality Bureau concluded that ambient CO levels in the Boise area are a function of both local traffic conditions and areawide meteorological conditions. The influence of local traffic conditions is illustrated by the degree to which changes in CO levels parallel changes in local traffic. Meteorological effects are evident from instances where CO levels "track" local traffic volumes for a period of time, then drop to low levels despite increased traffic flows. Such instances indicate a break-up of a ground

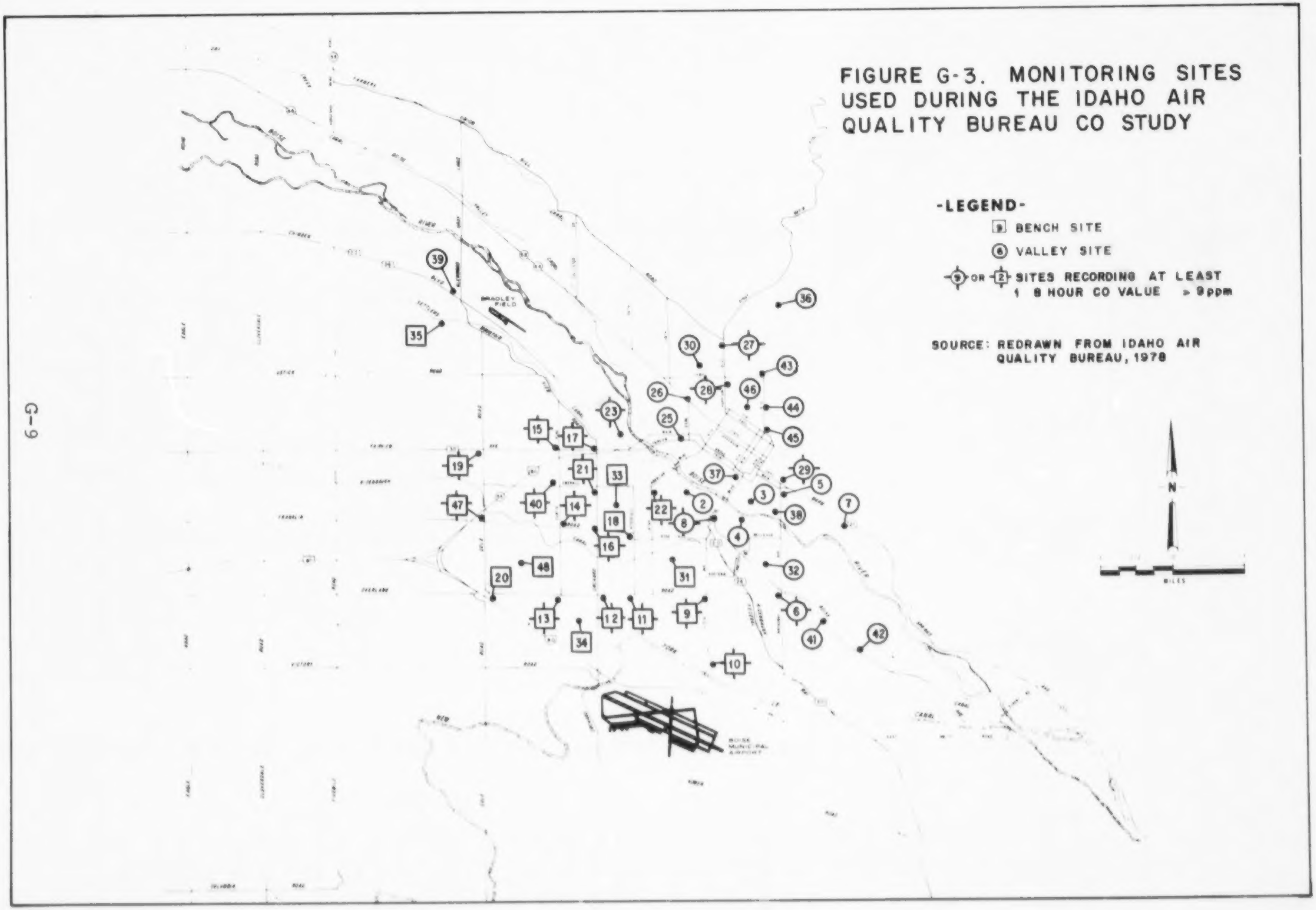


FIGURE G-3. MONITORING SITES USED DURING THE IDAHO AIR QUALITY BUREAU CO STUDY

-LEGEND-

▫ BENCH SITE

○ VALLEY SITE

⊕ OR ⊞ SITES RECORDING AT LEAST 1 8 HOUR CO VALUE > 9 ppm

SOURCE: REDRAWN FROM IDAHO AIR QUALITY BUREAU, 1978

N
MILES
BRADLEY FIELD
BOISE MUNICIPAL AIRPORT
39
35
36
30
27
43
26
28
46
44
23
25
45
15
17
19
21
33
37
29
5
2
3
7
40
14
22
38
47
18
8
4
16
20
48
31
32
13
12
11
9
6
41
42
34
10

Reproduced from best available copy.

Table G-3. Summary of CO Data Collected During the 1977-1978 Idaho Air Quality Bureau Study

General Monitoring Period[1]	Site #	Site Location Class[2]	Site Type[3]	Peak 8-Hour CO Episode at Monitoring Site: Value (ppm)	Date	Time Period	Simultaneous 8-Hour CO (ppm) At Ninth Street Monitoring Station
11-07-77	14	B	T	10.8	11-10-77	1 pm-9 pm	9.7
to	20	B	T	6.5	11-10-77	N-8 pm	NS
11-14-77	47	B	T	14.6	11-12-77	1 pm-9 pm	3.0
11-17-77 to 11-19-77	18	B	T	6.6	11-17/18-77	5 pm-1 am	7.5
11-21-77 to 11-28-77	45	V	T	6.9	11-25-77	N-8 pm	7.3
11-28-77	5	V	T	7.5	11-30-77	9 am-5 pm	9.0
to	6	V	T	17.7	11-30-77	3 pm-11 pm	9.4
12-05-77	29	V	T	10.6	12-02-77	10 am-6 pm	10.5
12-05-77	27	V	T	12.2	12-06-77	N-8 pm	5.8
to	28	V	T	10.5	12-06-77	N-8 pm	5.8
12-12-77	46	V	N	5.8	12-10/11-77	5 pm-1 am	10.7*
12-12-77	25	V	T	5.6	12-12-77	1 pm-9 pm	4.8
to	37	V	T	6.0	12-14-77	7 am-3 pm	3.8
12-19-77	38	V	T	4.9	12-14-77	10 am-6 pm	4.0
12-19-77	11	B	T	9.9	12-23-77	10 am-6 pm	18.4
to	12	B	T	21.0	12-22-77	11 am-7 pm	13.7
12-27-77	13	B	T	12.1	12-23-77	7 am-3 pm	16.5
12-26-77	15	B	T	12.0	12-29-77	11 am-7 pm	8.4
to	17	B	T	12.5	12-28-77	7 am-3 pm	8.8
01-02-78	19	B	T	11.6	12-30-77	N-8 pm	13.8
01-02-78	32	V	N	6.3	01-06-78	4 pm-M	9.9
to	41	V	T	5.5	01-06-78	11 am-7 pm	12.6
01-09-78	42	V	T	4.7	01-04-78	6 am-2 pm	10.0*
01-09-78	2	V	N	4.6	01-11-78	7 am-3 pm	10.2
to	22	B	T	11.2	01-13-78	1 pm-9 pm	9.6
01-16-78	31	B	N	8.4	01-12-78	4 am-N	6.4
01-16-78	8	V	T	9.1	01-18-78	7 am-3 pm	3.7*
to	9	B	T	15.5	01-19-78	1 pm-9 pm	8.2
01-23-78	10	B	T	10.0	01-19-78	2 pm-10 pm	8.2
01-23-78	16	B	T	16.8	01-27-78	4 pm-M	8.5
to	21	B	T	25.0	1-27/28-78	6 pm-2 am	8.9*
01-30-78	40	B	N	11.1	1-27/28-78	7 pm-3 am	8.9*
01-30-78	3	V	N	6.1	02-04-78	3 am-11 am	3.1
to	4	V	N	6.7	02-04-78	4 pm-M	6.9
02-06-78	7	V	T	5.8	02-04-78	1 pm-9 pm	6.0
02-06-78	35	B	T	6.7	02-08-78	6 am-2 pm	2.9
to	39	V	T	4.3	02-08-78	7 am-3 pm	3.0
02-13-78							
02-13-78	23	V	T	9.1	02-14-78	N-8 pm	7.3
to	34	B	N	3.3	02-14-78	[redacted]	3.6
02-20-78	48	B	N	3.5	02-16-78	6 am-2 pm	4.6
02-20-78	26	V	T	4.2	2-24/25-78	5 pm-1 am	4.1*
to	30	V	N	2.4	02-24-78	6 am-2 pm	4.2
02-27-78	36	V	N	2.6	02-24-78	7 am-3 pm	4.3
02-27-78	33	B	N	3.9	03-01-78	6 am-2 pm	4.4
to	43	V	T	4.1	03-05-78	4 pm-M	0.1
03-06-78	44	V	T	5.6	03-02-78	6 am-2 pm	1.3

Table G-3. Cont'd.

NOTES:

NR = No data reported
[1] Occasionally one station had a different starting or ending date
[2] B - bench site; V - valley bottom site
[3] T - traffic corridor station; N - neighborhood station
* Only 7 hours of data, with missing hour treated as 0

DATA SOURCE: Idaho Air Quality Bureau, 1978.

level temperature inversion. Meteorological influences are also suggested by instances when CO levels increased during evening and nighttime hours despite declining traffic volumes. Such events suggest reduced pollutant dispersion accompanying the formation of ground level temperature inversions. It is possible, however, that these episodes involve increased CO emissions from nontraffic sources or pollutant transport from other locations.

Airport wind data have been compared with wind data collected at the various monitoring sites. In general, data from the airport are not representative of wind speeds or directions at the valley sites. Airport wind direction data are generally representative of wind directions at the bench sites. Wind speeds reported at the bench sites were significantly lower than wind speeds at the airport.

A comparison of monitored CO levels, available traffic counts, airport meteorological data, and available monitoring site meteorological data shows several instances of neighborhood-scale transport of high CO levels. Most such pollution transport episodes did not, however, result in violation of the 8-hour CO standard except near other roadway corridors. Given the limited duration of this study, it is clear that air masses with high CO levels can be transported a moderate distance (perhaps 0.5-1 mile) from major traffic corridors.

This study did not reveal the type of areawide, peak CO episode shown by the EPA study (on December 2, 1977). During the 15 weeks when two or three instruments were operating concurrently, there was only one instance of all stations reporting their peak CO episode on the same day.

Air Quality Bureau
Monitoring Station Data

The Idaho Air Quality Bureau currently operates two permanent monitoring stations in Boise. The downtown station (at the Odd Fellows Hall on Ninth Street, southwest of Idaho Street) has operated since July 1975. The Orchard Street station (south of Highway 55) has operated since May 1978. Monitoring data from these stations are summarized in Tables G-4 and G-5.

The hourly pattern of CO levels in the downtown area is illustrated by Figure G-4. Both the morning and evening commute periods are evident from the monitoring data. The evening commute period shows a higher average CO value than the morning commute period. This is partially a reflection of the station location (near the intersection of two "outbound" streets). A more significant factor, however, involves the operating condition of cars in the local traffic flow. The evening commute period involves cars which are generally

Table G-4. Summary of Carbon Monoxide Data From the Boise Odd Fellows Hall Monitoring Station (Ambient CO Values in Parts Per Million By Volume)

Monitoring Period	Absolute Peak and Second High Values: 1-Hour Peak Value	Absolute Peak and Second High Values: 1-Hour Second High	Absolute Peak and Second High Values: Nonoverlapping 8-Hour Averages Peak Value	Absolute Peak and Second High Values: Nonoverlapping 8-Hour Averages Second High	Data Sorted for Maximum Number of 8-Hour Standard Exceedences: Peak Value	Data Sorted for Maximum Number of 8-Hour Standard Exceedences: Second High	Exceedences #	Exceedences Days	Extent of Data Record: Days	Extent of Data Record: Hours
1975										
July	8.8	6.5	4.9	4.4	4.9	4.4	0	0	16	384
August	16.5	14.0	10.3	9.6	10.3	9.6	2	2	31	669
September	18.5	17.0	7.9	7.6	7.9	7.6	0	0	15	311
October	19.3	15.3	10.0	7.9	10.0	7.9	1	1	8	168
November	28.0	26.8	15.9	12.8	14.6	12.8	9	7	25	466
December	30.5	30.5	19.7	17.5	15.4	15.3	22	15	25	527
Annual	30.5	30.5	19.7	17.5	15.4	15.3	34	25	120	2,525
1976										
January	35.8	30.8	16.4	14.4	16.4	14.3	15	11	29	611
February	23.3	21.0	13.1	11.4	11.4	10.9	10	9	29	669
March	19.3	18.3	9.5	8.8	9.5	8.8	1	1	31	717
April	18.8	16.8	10.9	10.8	10.9	10.8	6	6	30	680
May	14.5	13.0	10.8	8.3	10.8	8.3	1	1	31	699
June	14.0	12.0	9.8	8.9	9.8	8.9	1	1	30	681
July	14.8	12.5	9.1	8.7	9.1	8.7	1	1	31	643
August	14.3	13.3	9.2	8.6	9.2	8.6	1	1	31	702
September	20.3	19.0	12.3	10.8	9.7	9.6	5	4	28	633
October	32.9	31.5	13.7	12.4	13.7	12.4	13	12	23	494
November	32.2	28.4	19.7	13.4	15.4	13.4	28	18	30	688
December	33.7	28.3	18.3	16.9	16.9	15.6	34	22	31	684
Annual	35.8	33.7	19.7	18.3	16.9	16.4	116	87	354	7,901
1977										
January	25.3	24.6	18.0	14.9	17.9	13.4	26	19	31	698
February	20.3	19.2	12.4	11.9	11.9	11.3	9	8	26	569
March	11.7	11.7	6.7	5.7	6.7	5.7	0	0	31	724
April	8.2	8.2	5.8	5.0	5.8	5.0	0	0	28	630
May	7.6	7.6	4.6	4.0	4.6	4.0	0	0	28	606
June	11.0	10.7	6.3	5.3	6.3	5.3	0	0	24	496
July	15.8	15.2	10.1	9.4	10.1	9.4	2	2	18	405
August	14.2	13.5	11.2	10.7	11.2	10.7	3	3	20	449
September	14.9	14.6	10.7	8.2	10.7	8.2	1	1	29	657
October	40.9	31.4	13.9	11.9	13.9	11.9	6	6	31	697
November	39.5	24.0	15.1	11.4	15.1	10.7	13	11	30	683
December	25.6	23.0	18.4	15.4	17.1	13.4	16	13	31	727
Annual	40.9	39.5	18.4	18.0	17.9	17.1	76	63	327	7,341

Table G-4. Cont'd.

Monitoring Period	Absolute Peak and Second High Values: 1-Hour Peak Value	Absolute Peak and Second High Values: 1-Hour Second High	Absolute Peak and Second High Values: Nonoverlapping 8-Hour Averages Peak Value	Absolute Peak and Second High Values: Nonoverlapping 8-Hour Averages Second High	Data Sorted for Maximum Number of 8-Hour Standard Exceedences: Peak Value	Data Sorted for Maximum Number of 8-Hour Standard Exceedences: Second High	Exceedences #	Exceedences Days	Extent of Data Record Days	Extent of Data Record Hours
1978										
January	23.8	22.0	15.9	15.1	12.8	12.1	16	10	31	701
February	18.3	18.1	12.8	8.9	10.1	9.2	2	1	26	565
March	13.3	12.8	8.9	7.3	8.9	7.3	0	0	31	709
April	17.2	11.5	7.9	6.2	7.9	6.2	0	0	30	705
May	11.6	8.9	5.1	4.8	5.1	4.8	0	0	31	724
June	8.3	8.3	5.2	5.0	5.2	5.0	0	0	30	568
July	6.5	5.8	4.4	4.1	4.4	4.1	0	0	31	659
August	8.6	7.7	5.9	5.8	5.9	5.8	0	0	15	306
September	15.9	14.1	9.9	9.6	9.9	9.6	2	2	30	686
October	26.8	24.4	11.1	10.2	11.1	10.2	5	4	31	711
November	30.8	29.1	20.4	17.6	17.6	15.9	26	17	30	682
December	26.4	23.2	16.0	13.7	16.0	12.4	20	16	31	705
Annual	30.8	29.1	20.4	17.6	17.6	16.0	71	50	347	7,721
1979										
January	28.6	28.6	13.4	12.6	12.6	11.9	17	14	31	698
February	21.8	20.1	13.9	11.8	13.9	11.4	7	5	28	672
March	12.4	11.9	8.1	8.0	8.1	8.0	0	0	31	695
April	11.3	10.7	6.6	6.5	6.6	6.5	0	0	30	596
May	10.6	10.4	6.7	6.4	6.7	6.4	0	0	31	710
June	13.5	11.7	8.9	7.1	8.9	7.1	0	0	30	672
July	10.5	10.5	8.1	6.8	8.1	6.8	0	0	31	699
August	12.6	10.0	7.8	7.4	7.8	7.4	0	0	31	712
September	13.9	10.4	6.1	5.3	6.1	5.3	0	0	7	147
October	19.4	16.8	11.4	9.5	11.4	9.5	4	4	25	584
November	23.7	20.2	11.9	11.4	11.9	11.4	10	7	30	660
December	30.0	25.9	17.4	16.4	17.4	16.1	16	9	31	678
Annual	30.0	28.6	17.4	16.4	17.4	16.1	54	39	336	7,523
1980										
January	17.4	17.4	10.9	9.7	10.9	9.7	4	4	31	684
February	18.0	17.1	11.2	10.9	11.2	10.9	4	4	29	648
March										
April										
May										
June										
July										
August										
September										
October										
November										
December										
Annual										

DATA SOURCE: Hourly monitoring data from Idaho Air Quality Bureau.

Table G-5. Summary of Carbon Monoxide Data From the Central District Health Department Monitoring Station

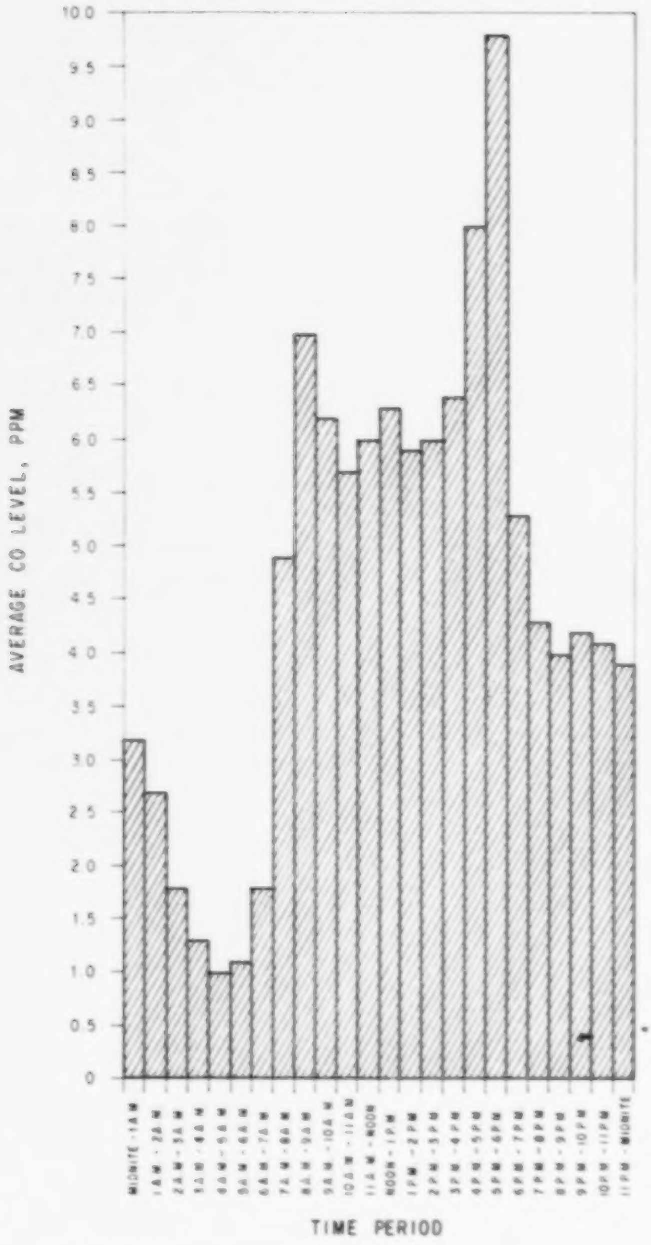
(Ambient CO Values in Parts Per Million by Volume)

Monitoring Period	Absolute Peak and Second High Values				Data Sorted for Maximum Number of 8-Hour Standard Exceedences				Extent of Data Record	
	1-Hour		Nonoverlapping 8-Hour Averages				Exceedences			
	Peak Value	Second High	Peak Value	Second High	Peak Value	Second High	#	Days	Days	Hours
1978										
May	8.7	8.5	5.0		5.0		0	0	22	512
June	10.7	8.7	4.6		4.6		0	0	30	705
July	10.5	10.5	5.6		5.6		0	0	31	741
August	9.7	9.3	5.8		5.8		0	0	23	550
September	12.7	12.2	6.7		6.7		0	0	11	256
October	18.2	16.3	9.5		9.5		1	1	6	100
November	21.3	17.3	9.5	9.4	9.5	9.4	2	2	30	719
December	16.5	16.3	10.4	10.3	10.4	10.3	3	3	27	611
Annual	21.3	18.2	10.4	10.3	10.4	10.3	6	6	180	4,194
1979										
January	18.7	17.0	9.5	9.2	9.5	9.2	2	2	31	692
February	17.2	17.0	12.1		10.3	9.1	2	2	27	636
March	16.5	16.2	6.7		6.7		0	0	31	732
April	13.8	9.1	5.1		5.1		0	0	30	717
May	9.3	8.9	4.8		4.8		0	0	21	490
June	9.1	8.6	5.7		5.7		0	0	28	632
July	9.6	9.5	5.1		5.1		0	0	31	688
August	10.7	9.8	5.6		5.6		0	0	29	654
September	18.3	16.9	8.7		8.7		0	0	30	676
October	27.5	20.0	12.6	12.5	12.6	12.5	7	4	31	696
November	18.0	17.5	11.8	11.8	11.8	11.8	2	2	30	657
December	29.5	24.2	12.8	12.6	12.8	12.4	7	5	31	699
Annual	29.5	27.5	12.8	12.6	12.8	12.6	20	15	350	7,969
1980										
January	13.9	13.5	7.1		7.1		0	0	31	692
February	15.3	13.3	7.4		7.4		0	0	29	645
March										
April										
May										
June										
July										
August										
September										
October										
November										
December										
Annual										

DATA SOURCE: Hourly monitoring data from Idaho Air Quality Bureau.

FIGURE G-4

AVERAGE WINTER CARBON MONOXIDE LEVELS
AT THE BOISE ODD FELLOWS HALL
MONITORING STATION



NOTE: BASED ON OCTOBER THROUGH FEBRUARY DATA

DATA SOURCE: OCTOBER 1975 - FEBRUARY 1980 HOURLY
CO DATA FROM IDAHO AIR QUALITY
BUREAU

in a "cold" operating mode (with high emission rates). A significant portion of the morning commute traffic will be in a warmed-up operating mode (with lower emission rates).

An interesting contrast to the downtown station is provided by the Orchard Street station. The pattern of hourly CO levels at this site (Figure G-5) shows a predominance of the morning commute pattern. A major factor here, as at the downtown site, is the cold vs. warmed-up condition of vehicles in the local traffic flow.

The downtown and Orchard monitoring stations show distinctive patterns in the occurrence of 8-hour CO values exceeding the 9 ppm standard. Data from the downtown station are summarized in Figure G-6. Most episodes occur during time periods which include the mid-afternoon and early evening periods. The Orchard site (Figure G-7) shows a pattern which has two distinct periods of episode conditions. High CO levels tend to occur during the morning to early afternoon period and again during the evening to late night time period. To a large extent, this is probably a reflection of shopping and other nonwork trips.

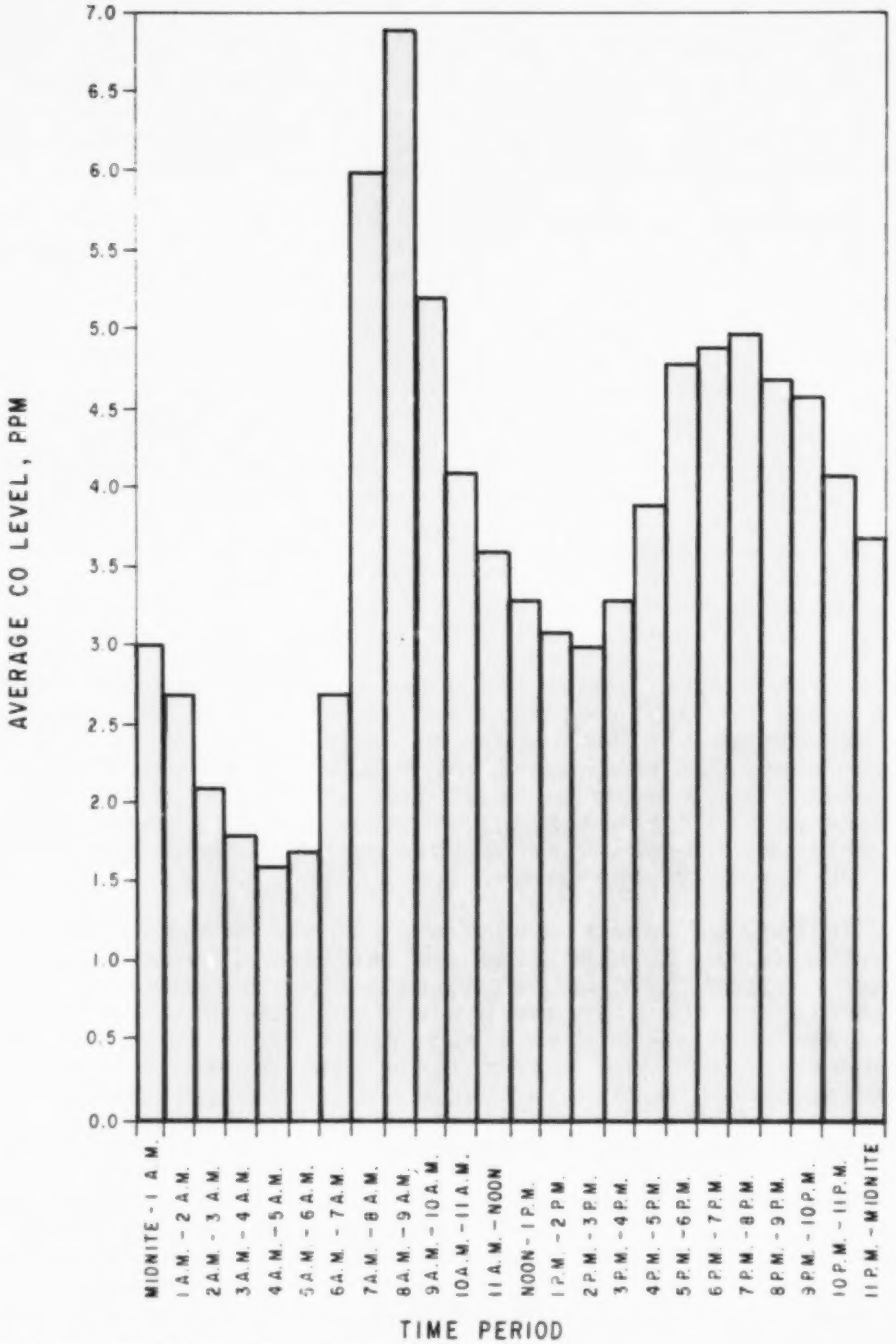
The evening and nighttime CO episodes observed at the Orchard site are also apparent from the special monitoring program that was conducted by the Idaho Air Quality Bureau. While traffic sources have been suggested as the major cause of these episodes, households using wood stoves or fireplaces are another potential source. Carbon monoxide emissions from these sources are discussed later in this chapter. With one exception, the "neighborhood" sites used in the Air Quality Bureau study did not exceed the 8-hour CO standard. The one exception appears to be a clear case of CO transport from major traffic arteries. Thus, there is little evidence to implicate nonvehicular sources as major contributors to high CO levels on the bench.

It is also possible that some of the nighttime CO episodes recorded at the Orchard site are influenced by pollutant transport from the downtown Boise area. The times of high CO levels and the distance between the downtown and Orchard sites are consistent with a slow drift of polluted air to the bench area. Cold air drainage into the Boise Valley could provide a mechanism that would lift a polluted but warmer air mass up to the level of the bench while also carrying it in a westerly direction.

The pattern of CO episodes at the Orchard site is also consistent with a localized traffic source combined with formation of nighttime ground level temperature inversions. Carbon monoxide transport has seldom been documented over distances exceeding 1 mile. Monitoring data from the special

FIGURE G-5

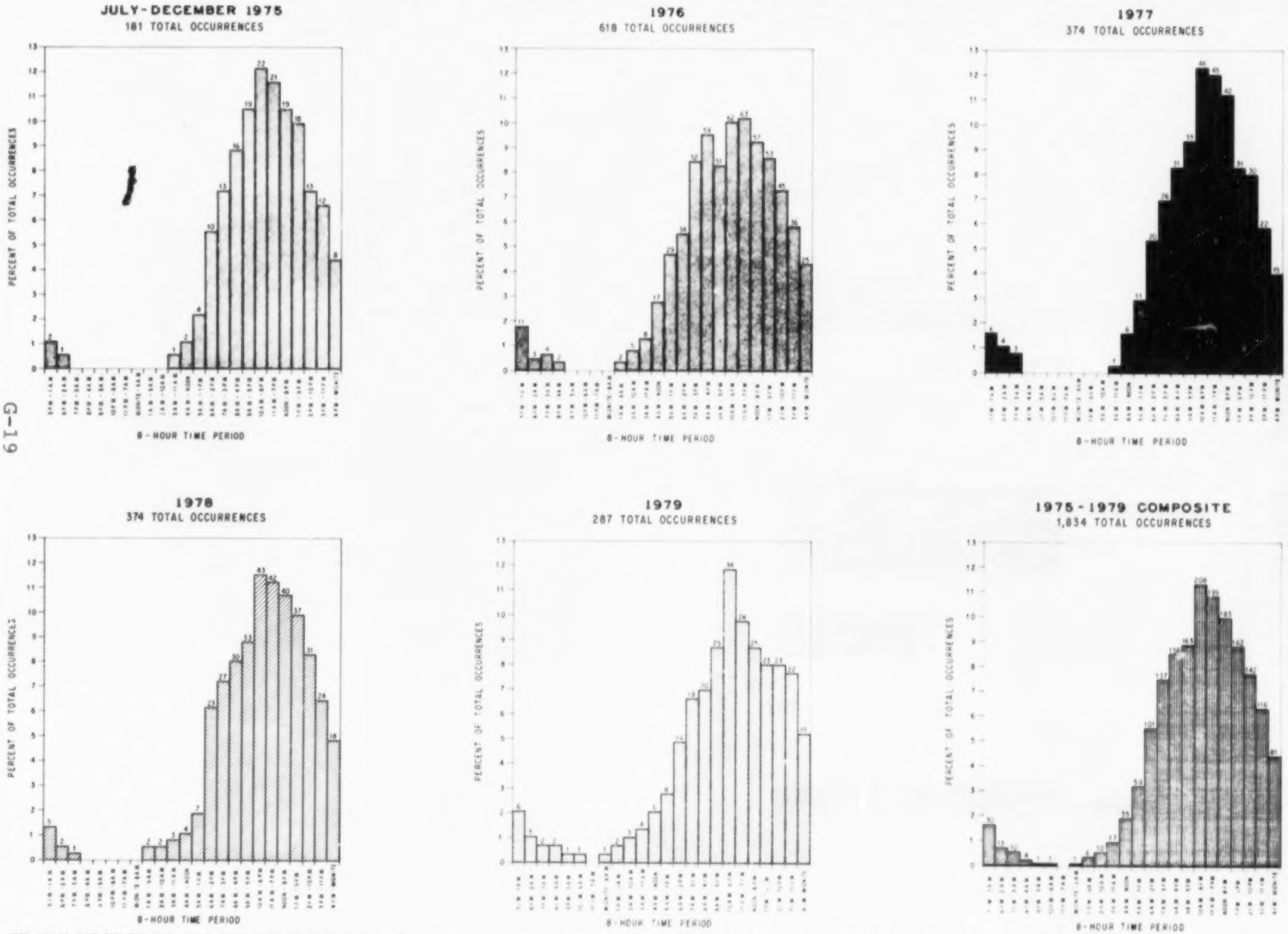
AVERAGE WINTER CARBON MONOXIDE LEVELS AT THE CENTRAL DISTRICT HEALTH DEPARTMENT MONITORING STATION



NOTE: BASED ON OCTOBER THROUGH FEBRUARY DATA.

DATA SOURCE: OCTOBER 1978 - FEBRUARY 1980 HOURLY CO DATA
FROM IDAHO AIR QUALITY BUREAU.

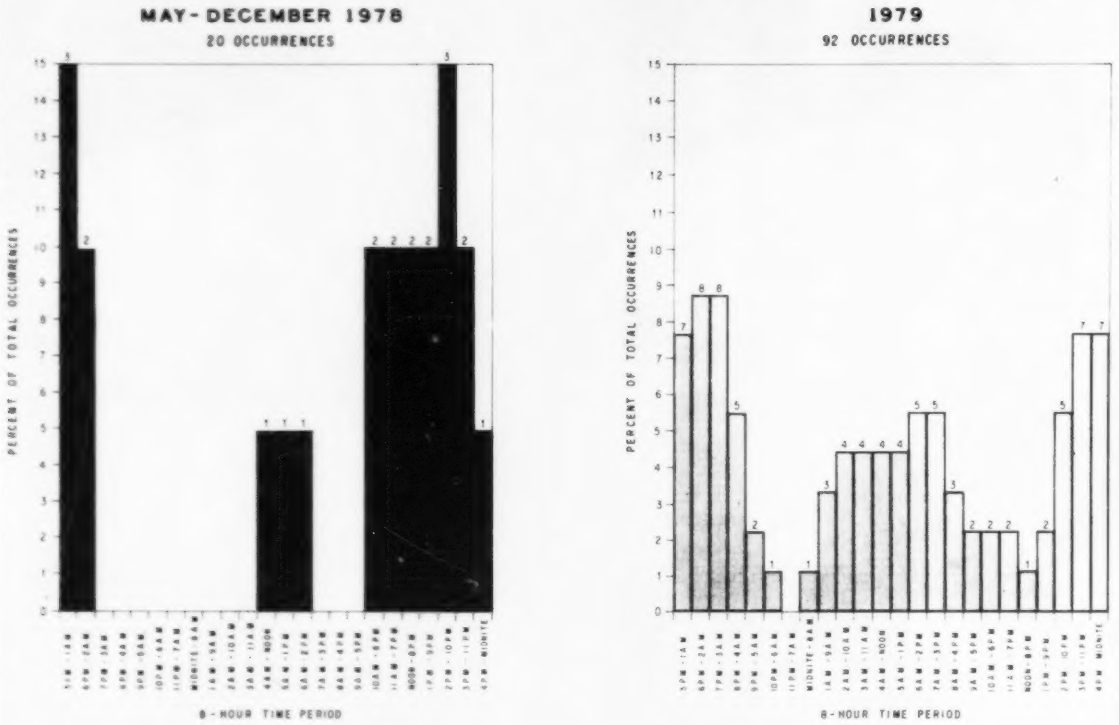
FIGURE G-6
TIME PERIODS WITH 8-HOUR CO LEVELS > 9.0 PPM
AT THE BOISE ODD FELLOWS HALL MONITORING STATION



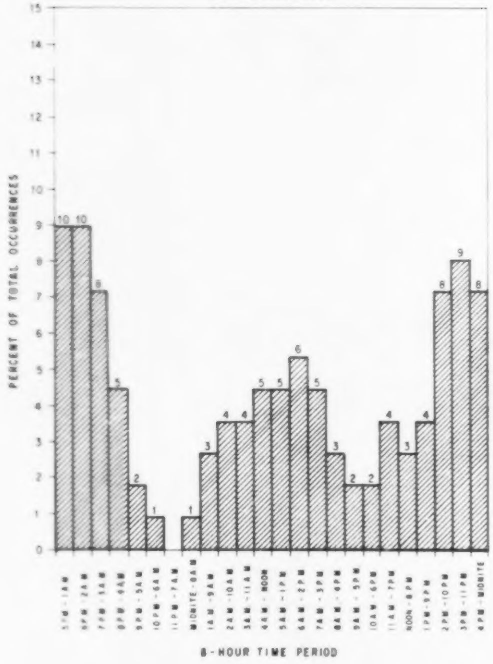
NOTE: VALUES ABOVE FREQUENCY GRAPH INDICATE NUMBER OF OCCURRENCES FOR SPECIFIED TIME PERIOD

DATA SOURCE: HOURLY CO DATA FROM IDAHO AIR QUALITY BUREAU

FIGURE G-7
TIME PERIODS WITH 8-HOUR CO LEVELS > 9.0 PPM AT CENTRAL DISTRICT HEALTH DEPARTMENT MONITORING STATION



1978-1979 COMPOSITE
112 OCCURRENCES



NOTE VALUES ABOVE FREQUENCY GRAPH INDICATE NUMBER OF OCCURRENCES FOR SPECIFIED TIME PERIOD

DATA SOURCE HOURLY CO DATA FROM IDAHO AIR QUALITY BUREAU studies discussed previously do not document CO transport on this distance scale. The differences in nighttime CO patterns at the downtown and Orchard Street sites could also reflect dilution of valley CO concentrations by relatively clean cold air drainage flows. These light winds could result in mixing of a polluted air mass in the valley with clean air flowing down from the Boise Front. At the same time, the bluff face on the southwest side of the Boise River could serve to block westerly ground level air flows, shifting them to the northwest.

Considering all available data and the speculations discussed above, CO transport from the downtown area to the bench area must be considered an interesting but unproven possibility. It is quite likely that both types of drainage wind influences discussed above occur on some occasions. Most likely, there is a range of situations from "pure" within-valley transport and dilution to "pure" valley to bench transport. Available evidence suggests that the valley-to-bench transport condition is a rare occurrence.

Idaho Transportation Department Monitoring Data

The Idaho Transportation Department operates a continuous CO monitor at its laboratory building off of State Street. Data have been collected since December 1975. No statistical data summaries are available. A preliminary review of the hourly data indicate five episodes of 8-hour CO levels above the federal standard (one in 1976 and four in 1979). The highest 8-hour CO value appears to be a 10.6 ppm average on November 16, 1979 (7:00 a.m.-3:00 p.m.). All of these episodes occurred during the early morning to early afternoon time period. The highest 1-hour CO level reported was 30 ppm on February 17, 1976 at 8:00 a.m. to 9:00 a.m. The pattern of hourly CO levels strongly suggests the influence of local vehicle parking activities plus some pollutant transport from other areas.

Summary

Available monitoring data from several sources indicate that the Boise area experiences a geographically extensive pattern of high CO levels. These high CO levels are concentrated primarily along major traffic corridors. Under appropriate meteorological conditions (light winds and low level temperature inversions), air masses containing high CO levels can be transported more or less intact over distances of up to 1 mile. Thus, much of the Boise area is susceptible to episodes of high CO levels which originate primarily from major roadway corridors.

Episodes of high CO levels show a rather strong seasonal pattern, with most episodes occurring during the winter (November-February). However, there have been instances of 8-hour CO levels above the federal standard during every month of the year and almost every possible 8-hour period of the day. The seasonality, frequency, and magnitude of CO episodes show significant yearly variation.

The valley and bench areas in Boise both experience severe CO episodes. The hourly patterns of high CO episodes in these two areas are rather distinctive. While these patterns could be produced in several ways, the simplest explanation centers around differences in the pattern of vehicle activity. Vehicle emissions are clearly the source of CO problems in the Boise area. The frequency and magnitude of CO episodes, however, is strongly influenced by the meteorological and topographic conditions of the area.

BIBLIOGRAPHY

Reference Documents

Bellin, Peter, and John D. Spengler. 1980. Indoor and outdoor carbon monoxide measurements at an airport. J. Air Pollut. Control Assoc. 30(4):392-394.

Calif. Air Resources Board. 1971. Outdoor-indoor levels of air pollutants. ARB no. 4-053-1 (PCA 252). Sacramento. 6 pp. + appendices.

ESL, Inc., and CH2M Hill. 1974. Ambient air quality measurements in the Boise, Idaho, urban area. Prepared for Idaho Transportation Dept. and Ada County Highway District.

Idaho. Air Quality Bureau. 1978. Boise carbon monoxide study, winter 1977-spring 1978, Boise, Idaho: staff report.

U.S. Environmental Protection Agency. 1978. Carbon monoxide study, Boise, Idaho, Nov. 25-Dec. 22, 1977, parts 1 and 2. Prepared by C. B. Wilson and J. W. Schweiss, Surveillance and Analysis Division, Boise.

Yocom, John E., William A. Coté, and Ferris B. Benson. 1977. Effects on indoor air quality. Pp.117-155 in Arthur C. Stern, ed., Air pollution, vol. II. 3rd ed. Academic Press, New York.

Appendix H

PROCEDURES USED TO EVALUATE FUTURE AIR POLLUTION POTENTIAL IN ADA COUNTY

Prepared by:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

February 1981

PROCEDURES USED TO EVALUATE FUTURE AIR POLLUTION POTENTIAL IN ADA COUNTY

The air quality assessment in Chapter 7 of the EIS used a simple proportionality procedure to evaluate future air pollution potential and the extent of emission reductions needed to achieve air quality standards. Observed ambient air quality is considered to be composed of two components: a "background" component due to total areawide emissions, and a highway corridor component due to highway traffic and nonresidential parking sources. Each community planning area was treated as a discrete subarea. The following equations were used in the analysis.

$$AQ_{fy} = \left(\frac{CE_{fy}}{CE_{by}}\right) \left(AQ_{by} - B_{by}\right) + B_{fy}$$

$$B_{fy} = \left(\frac{TE_{fy}}{TE_{by}}\right) \left(B_{by}\right)$$

$$EL = \left(\frac{S - B_{fy}}{AQ_{by} - B_{by}}\right) \left(CE_{by}\right)$$

$$\text{Rollback amount} = CE_{fy} - EL$$

$$\text{Rollback percent} = \left(\frac{CE_{fy} - EL}{CE_{fy}}\right) \left(100\right)$$

Where:

AQ = ambient air quality

B = background increment contained in ambient air quality

CE = corridor emissions (highway traffic plus on- and off-street parking sources)

TE = total emissions

EL = emissions limit

S = ambient air quality standards

subscripts: by = base year (1977)
fy = forecast year

* GPO 797 - 421 1981